

PANASONIC CT-2511HDB SERVICE MANUAL



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Simplified

Simplified Manual
(NA6LM)



Appearance and inputs may vary depending on model

Panasonic

Models	Chassis
CT-2511HDB	AP335
CT-2521HDB	BP355
CT-2721HDB	BP307
CT-3221HDB	AP357

This Simplified Service manual is issued as a service guide for the models of the **NA6LM** family listed above. Included in this manual are a set of schematic, functional descriptions, alignment procedures, disassembly procedures, and a complete parts list. For Block Diagrams Refer to **Main Manual MTC9905021C1 (CT-2720HA)**.

"WARNING! This Service Manual is designed for experienced repair technicians only and is not designed for use by the general public. It does not contain warnings or cautions to advise non-technical individuals of potential dangers in attempting to service a product. **Products powered by electricity should be serviced or repaired only by experienced professional technicians.** Any attempt to service or repair the product or products dealt with in this Service Manual by anyone else could result in serious injury or death."

The service technician is required to read and follow the **"Safety Precautions"** and **"Important Safety Notice"** in this Manual.

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Important Safety Notice

Special components are used in this television set which are important for safety. These parts are identified on the schematic diagram by the symbol  and printed in **BOLD TYPE** on the replacement part list. It is essential that these critical parts are replaced with the manufacturer's specified replacement part to prevent X-ray radiation, shock, fire or other hazards. Do not modify the original design without the manufacturer's permission.

Safety Precautions

General Guidelines

An **Isolation Transformer** should always be used during the servicing of a receiver whose chassis is not isolated from AC power line. Use a transformer of adequate power rating as this protects the technician from accidents resulting in personal injury from electrical shocks. It will also protect the Receiver from being damaged by accidental shorting that may occur during servicing.

When servicing, observe the original lead dress, especially in the high voltage circuit. Replace all damaged parts (also parts that show signs of overheating.)

Always Replace Protective Devices, such as fishpaper, isolation resistors and capacitors, and shields after servicing the Receiver. Use only manufacturer's recommended rating for fuses, circuits breakers, etc.

High potentials are present when this Receiver is operating. Operation of the Receiver without the rear cover introduces danger for electrical shock. Servicing should not be performed by anyone who is not thoroughly familiar with the necessary precautions when servicing high-voltage equipment.

Extreme care should be practiced when **Handling the Picture Tube**. Rough handling may cause it to implode due to atmospheric pressure. (14.7 lbs per sq. in.). Do not nick or scratch the glass or subject it to any undue pressure. When handling, use safety goggles and heavy gloves for protection. **Discharge the picture tube** by shorting the anode to chassis ground (not to the cabinet or to other mounting hardware). When discharging connect cold ground (i.e. dag ground lead) to the anode with a well insulated wire or use a grounding probe.

Avoid prolonged exposure at close range to unshielded areas of the picture tube to prevent exposure to X-ray radiation.

The **Test Picture Tube** used for servicing the chassis at the bench should incorporate safety glass and magnetic shielding. The safety glass provides shielding for the tube viewing area against X-ray radiation as well as implosion. The magnetic shield limits the X-ray radiation around the bell of the picture tube in addition to the restricting magnetic effects. When using a picture tube test jig for service, ensure that the jig is capable of handling **50.0kV** without causing X-ray radiation.

Before returning a serviced receiver to the owner, the service technician must thoroughly test the unit to ensure that it is completely safe to operate. **Do not use a line isolation transformer when testing.**

Leakage Current Cold Check

Unplug the AC cord and connect a jumper between the two plug prongs.

Measure the resistance between the jumpered AC plug and expose metallic parts such as screwheads,

antenna terminals, control shafts, etc. If the exposed metallic part has a return path to the chassis, the reading should be between 240k Ω and 5.2M Ω . If the exposed metallic part does not have a return path to the chassis, the reading should be infinite.

Leakage Current Hot Check (Fig. 1)

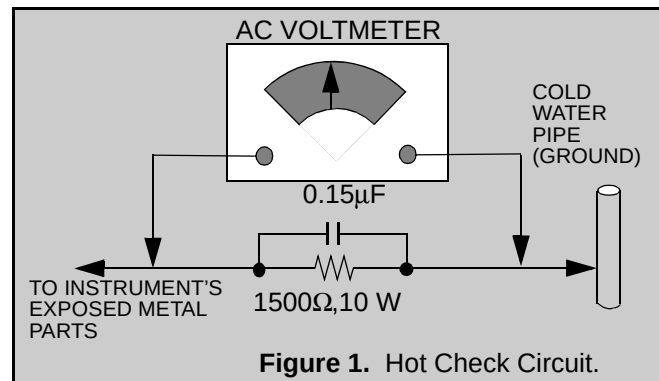
Plug the AC cord directly into the AC outlet. Do not use an isolation transformer during the check.

Connect a 1.5k Ω 10 watt resistor in parallel with a 0.15 μ F capacitor between an exposed metallic part and ground. Use earth ground, for example a water pipe.

Using a DVM with a 1000 ohms/volt sensitivity or higher, measure the AC potential across the resistor.

Repeat the procedure and measure the voltage present with all other exposed metallic parts.

Verify that any potential does not exceed 0.75 volt RMS. A leakage current tester (such a Simpson Model 229, Sencore Model PR57 or equivalent) may be used in the above procedure, in which case any current measure must not exceed 1/2 milliamper. If any measurement is out of the specified limits, there is a possibility of a shock hazard and the Receiver must be repaired and rechecked before it is returned to the customer.



X-ray Radiation

WARNING: The potential source of X-ray radiation in the TV set is in the High Voltage section and the picture tube.

Note: *It is important to use an accurate, calibrated high voltage meter.*

Set the **brightness, picture, sharpness and color** controls to Minimum.

Measure the High Voltage. The high voltage should be **29.25kV $\pm$ 1.25kV for 25", 27", and 32"**. If the upper limit is out of tolerance, immediate service and correction is required to insure safe operation and to prevent the possibility of premature component failure.

Horizontal Oscillator Disable Circuit Test

This test must be performed as a final check before the Receiver is returned to the customer. See **Horizontal Oscillator Disable Circuit Procedure Check** in this manual.

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Service Notes

Note: These components are affixed with glue. Be careful not to break or damage any foil under the component or at the pins of the ICs when removing. Usually applying heat to the component for a short time while twisting with tweezers will break the component loose.

Leadless Chip Component (surface mount)

Chip components must be replaced with identical chips due to critical foil track spacing. There are no holes in the board to mount standard transistors or diodes. Some chips capacitor or resistor board solder pads may have holes through the board, however the hole diameter limits standard resistor replacement to 1/8 watt. Standard capacitor may also be limited for the same reason. It is recommended that identical components be used.

Chip resistors have a three digit numerical resistance code - 1st and 2nd significant digits and a multiplier. Example: 162 = 1600 or 1.6k Ω resistor, 0 = 0 Ω (jumper). Chip capacitors generally do not have the value indicated on the capacitor. The color of the component indicates the general range of the capacitance.

Chip transistors are identified by a two letter code. The first letter indicates the type and the second letter, the grade of transistor.

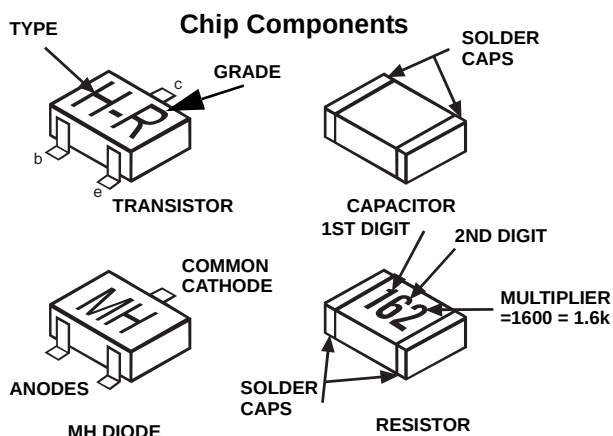
Chip diodes have a two letter identification code as per the code chart and are a dual diode pack with either common anode or common cathode. Check the parts list for correct diode number.

Component Removal

1. Use solder wick to remove solder from component end caps or terminal.
2. Without pulling up, carefully twist the component with tweezers to break the adhesive.
3. Do not reuse removed leadless or chip components since they are subject to stress fracture during removal.

Chip Component Installation

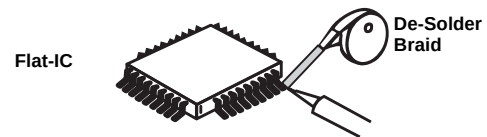
1. Put a small amount of solder on the board soldering pads.
2. Hold the chip component against the soldering pads with tweezers or with a miniature alligator clip and apply heat to the pad area with a 30 watt iron until solder flows. Do not apply heat for more than 3 seconds.



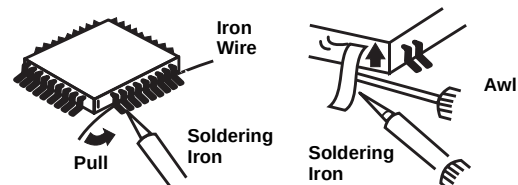
How to Replace Flat-IC

- Required Tools -

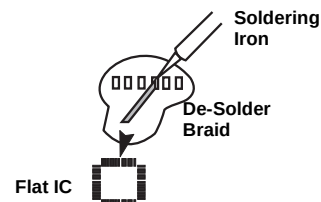
- Soldering iron
 - De-solder braids
 - Iron wire or small awl
 - Magnifier
1. Remove the solder from all of the pins of a Flat-IC by using a de-solder braid.



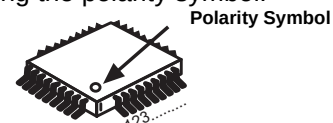
2. Put the iron wire under the pins of the Flat-IC and pull it in the direction indicated while heating the pins using a soldering iron. A small awl can be used instead of the iron wire.



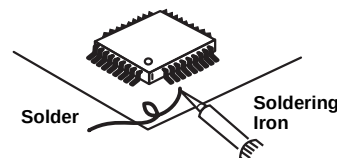
3. Remove the solder from all the pads of the Flat-IC by using a de-solder braid.



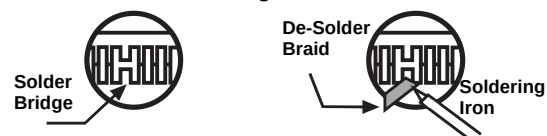
4. Position the new Flat-IC in place (apply the pins of the Flat-IC to the soldering pads where the pins need to be soldered). Properly determine the positions of the soldering pads and pins by correctly aligning the polarity symbol.



5. Solder all pins to the soldering pads using a fine tipped soldering iron.



6. Check with a magnifier for solder bridge between the pins or for dry joint between pins and soldering pads. To remove a solder bridge, use a de-solder braid as shown in the figure below.



Service Notes (Continued)

IMPORTANT: To protect against possible damage to the solid state devices due to arcing or static discharge, make certain that all ground wires and CTR DAG wire are securely connected.

CAUTION: The power supply circuit is above earth ground and the chassis cannot be polarized. Use an isolation transformer when servicing the Receiver to avoid damage to the test equipment or to the chassis. Connect the test equipment to the proper ground (⚡) or (↗) when servicing, or incorrect voltages will be measured.

WARNING: This Receiver has been designed to meet or exceed applicable safety and X-ray radiation protection as specified by government agencies and independent testing laboratories.

To maintain original product safety design standards relative to X-ray radiation and shock and fire hazard, parts indicated with the symbol ⚠ on the schematic must be replaced with identical parts. Order parts from the manufacturer's parts center using the parts numbers shown in this service manual, or provide the chassis number and the part reference number.

For optimum performance and reliability, all other parts should be replaced with components of identical specification.

Horizontal Oscillator Disable Circuit

This chassis employs a special circuit to protect against excessive high voltage and beam current. If, for any reason, the high voltage and beam current exceed a predetermined level this protective circuit activates and detunes the horizontal oscillator that limits the high voltage. The over-voltage protection circuit is not adjustable. However, if components indicated by the symbol ⚠ on the schematic in either the horizontal sweep system or the over-voltage protection circuit itself are changed, the operation of the circuit should be checked using the following procedure:

Equipment needed to check the disabled circuit:

1. Voltmeter (0 - 200V scale)
2. High Voltage Meter (0- 50kV)
3. Variac or Isolation Transformer

Procedure:

1. Tune in a station to verify that the horizontal is in sync.
2. Obtain a Monoscope pattern or a signal generator crosshatch pattern
3. Connect the voltmeter (-) lead to TPD2 and the (+) lead to TPD1 (junction of D555 anode, R556 & R557). Set **Bright** level to (0) and **Picture** for a 1.8 volt reading on the voltmeter.
4. Turn the Receiver OFF. Connect a jumper across IC803 pin 3 and pin 4.
5. Reduce the AC supply voltage to approximately 45V. Connect the high voltage meter to the CRT anode (H.V. button).

Note: Use the Dag Ground (C10 on the CRT Board) to connect the (-) lead of the meter.

6. Turn the Receiver ON. Slowly increase the AC supply voltage and verify that the high voltages does not exceed **35.1kV for 25" models** and **37.1kV for 27" models, 39.3kV for 32" models** when horizontal just begins to pull out of sync. If the high voltage is not within the specified limit, the cause must be determined and corrected before the receiver is returned to the customer.

Receivers Feature Table

FEATURE\MODEL	CT-2511HDB	CT-2521HDB	CT-2721HDB	CT-3221HDB
Chassis	NA6LM	NA6LM	NA6LM	NA6LM
Tuning system	40K	40K	40K	40K
# of channels	181	181	181	181
Menu language	Eng	Eng	Eng	Eng
Closed Caption	X	X	X	X
V-Chip	X	X	X	X
75 Ω input	X	X	X	X
Remote	SEPARATELY	SEPARATELY	SEPARATELY	SEPARATELY
Picture tube	A63QDB891X	A63QDB891X	M68LG061X	M80JUA061X
CRT	SAMSUNG	SAMSUNG	AMEC	AMEC
V NORM	X	X	X	X
Notch Filter	P	P	P	P
Control Panel Lock	X	X	X	X
Auto ON	X	X	X	X
AI Sound	X (always on)	X (always on)	X (always on)	X (always on)
Built-in audio power	1.5Wx2 (10%)	1.5Wx2 (10%)	1.5Wx2 (10%)	1.5Wx2 (10%)
# of speakers	2	2	2	2
A/V in (rear/front)	1/0	1/1	1/1	1/1
Interface	--	Smart Plug	Smart Plug	Smart Plug
Speaker Out	--	X (Mono/Fixed)	X (Mono/Fixed)	X (Mono/Fixed)
Dimensions mm (HxWxD) in	568x633.4x491.8 23.14x24.92x19.36	568x633.4x491.8 23.14x24.92x19.36	594.8x665.2x545 23.41x26.18x21.45	694.4x770x535.5 27.33x30.31x21.08
Weight (kg/lbs)	29.7/65.47	29.7/65.47	34.9/77	49.6/109.12
Power source (V/Hz)	120/60	120/60	120/60	120/60
Anode voltage	29.25kV $\pm$ 1.25kV	29.25kV $\pm$ 1.25kV	29.25kV $\pm$ 1.25kV	29.25kV $\pm$ 1.25kV
Video input jack	1V _{p-p} 75 Ω , phono jack	1V _{p-p} 75 Ω , phono jack	1V _{p-p} 75 Ω , phono jack	1V _{p-p} 75 Ω , phono jack
A-Board TNP2AH008	FF	FG	FH	FJ
C-Board TNP2AA034	AH	AH	AK	AJ
DI-Board TNP2AA072	--	NIL	NIL	NIL
Z-Board TNP2AA010	--	--	--	AE

Table 1. Receiver Features

Specifications are subject to change without notice or obligation.
Dimensions and weights are approximate.

Location of Controls (Receiver)

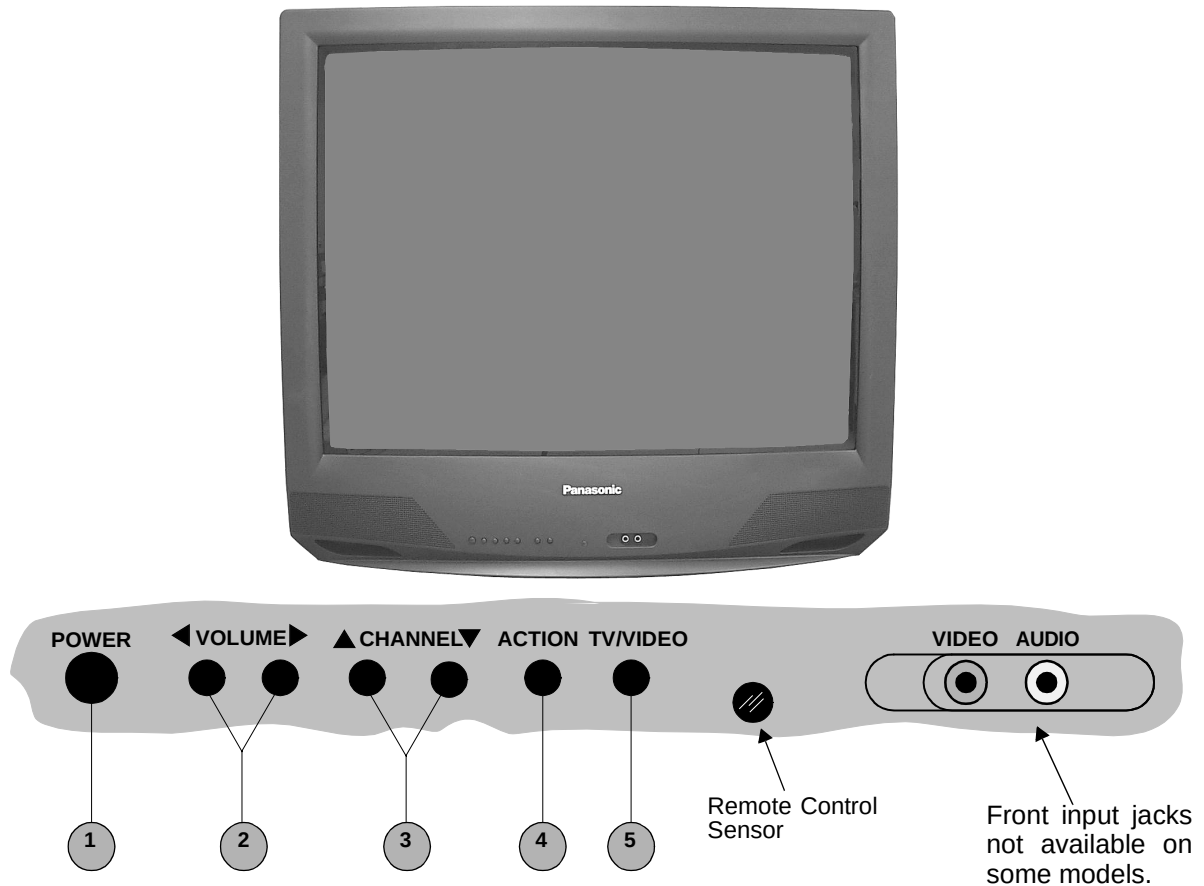


Figure 2. Location of Controls Receiver

Quick Reference Control Operation

Quick Reference Control Operation	
1	Power - Press to turn ON or OFF.
2	Volume - Press to adjust Sound Level, or to adjust Audio Menus, Video Menus, and select operating features when menus are displayed
3	Channel - Press to select programmed channels. Press to highlight desired features when menus are displayed. Also use to select Cable Converter box channels after programming Remote Control Infra-red codes (the TV/AUX/CABLE switch must be set in CABLE position).
4	Action - Press to display Main Menu and access On Screen feature and Adjustment Menus.
5	TV/Video - Press to select TV or one of two Video Inputs, for the Main Picture or the PIP frame (when PIP frame is displayed).

Disassembly for Service

Back Cover

Remove all the screws marked with an arrow() from the back of the Receiver (Fig. 3).

Note: Screw configuration, type, and number of screws vary depending on the model of the Receiver serviced and the application; various models are covered in this Manual. Use same hardware when reassembling the receiver.

- 3 screws at the top edge of the Receiver.
- 1 screw at each lower corner of the Receiver.
- 1 screw by the A/V jacks.
- 1 screw by the Flyback assembly.
- 1 screw by the Digital input. (some models)

A-Board - Main Chassis (Fig. 6)

1. Slide the chassis completely out of the guide rails.
2. Stand the Receiver on its edge. The underside of the board is completely accessible for component replacement.

Note: Some tie-wraps that secure the wire dressings may need to be unfastened for chassis removal.

C-Board - CRT Output

Plugs into the socket on the CRT neck.

DI-Board (some models)

Plugged onto A-Board, behind A/V jacks. Has also a screw to Back Cover.

Z-Board (some models)

Plugged onto Main panel.

Speakers

Each speaker is secured to the front of cabinet with 4 screws.

Keyboard Push Button Assembly

Fastened to the inside of the cabinet front with up to 3 screws.

Disassembly for CRT Replacement

1. Discharge the CRT as instructed in the **Safety Precautions** (page 2).
2. Disconnect the yoke (DY) plug, degaussing coil (DEG) plug and the CRT 2nd anode button from the main board.
3. Remove the C-Board from the CRT base and unplug the black wire (CRT dag ground) C10.
4. Disconnect the A11, A12, and Speakers plugs from the A-Board.
5. Lift the Main Chassis (A-Board) and all mounted boards completely out with the CRT Board attached.
4. Remove the CRT with the degaussing coil and the dag ground braid attached.
5. Note the original locations and mounting of the degaussing coil and the dag ground assembly to insure proper reinstallation on the replacement CRT.

CRT Replacement

1. Insure that the CRT H.V. Anode button is discharged before handling the CRT. Read the **Safety Precautions** (page 2) on handling the picture tube.
2. Remove the components from the CRT neck and place the cabinet face down on a soft pad.
3. Note the original order for the CRT mounting hardware as they are remove from the CRT mounting brackets at each corner of the CRT.
- To remove and re-mount the degaussing coil:**
The degaussing coil is held in place by clampers fastened to the CRT corner ears. These clampers must be installed onto the replacement CRT prior to mounting the degaussing coil.
- To remove and re-mount the dag ground braid:**
 - a. Unhook the coil spring from the bottom corners of the CRT ears.
 - b. Release the braid loop from the upper corners of the CRT ears.
6. Mount the dag ground braid on the replacement CRT. Position the degaussing coil with new ties. Dress coil as was on the original CRT.
7. Replace the components on CRT neck and reinstall into cabinet. Verify that all ground wires and circuit board plugs get connected.

Location of Screws

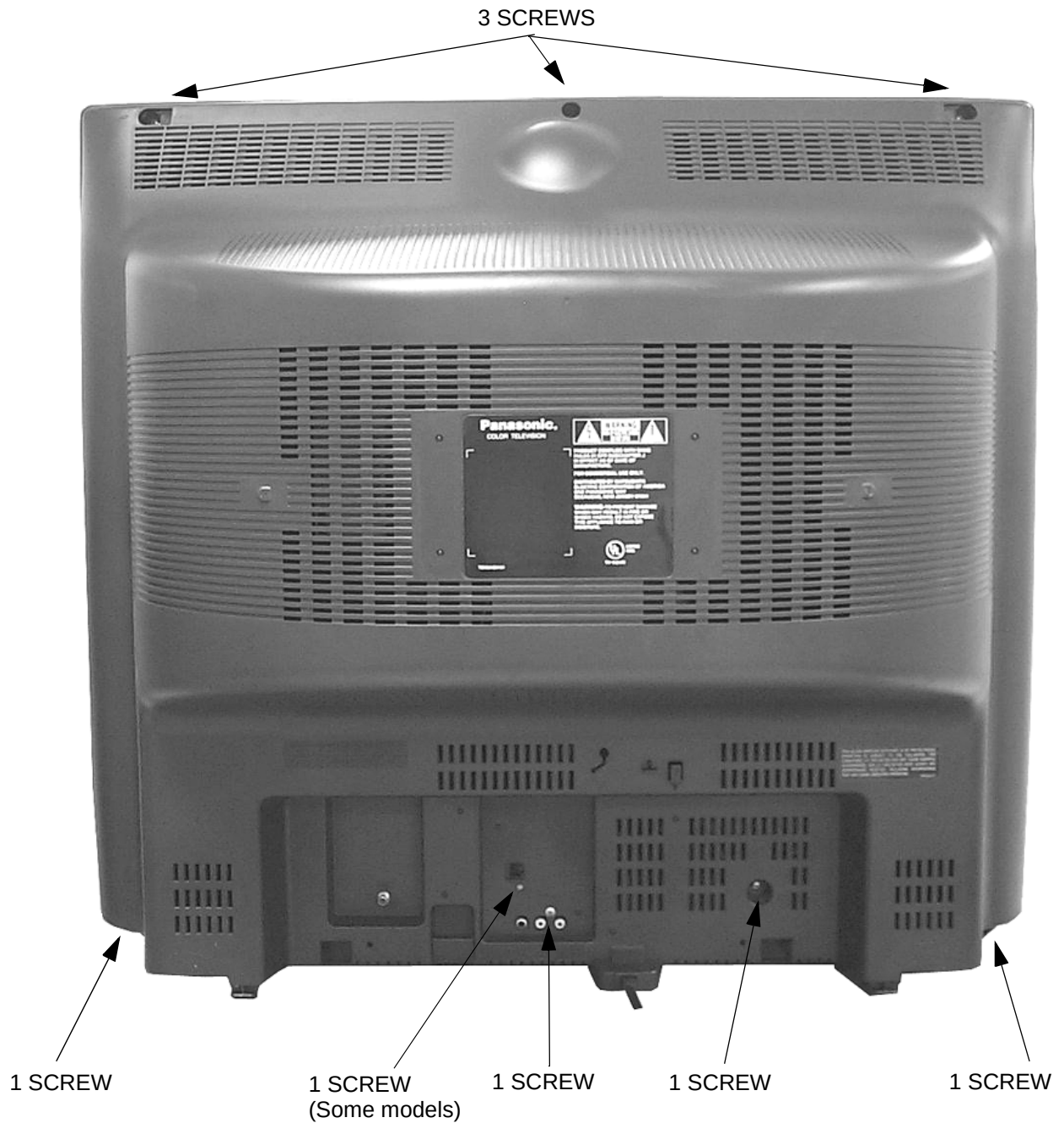
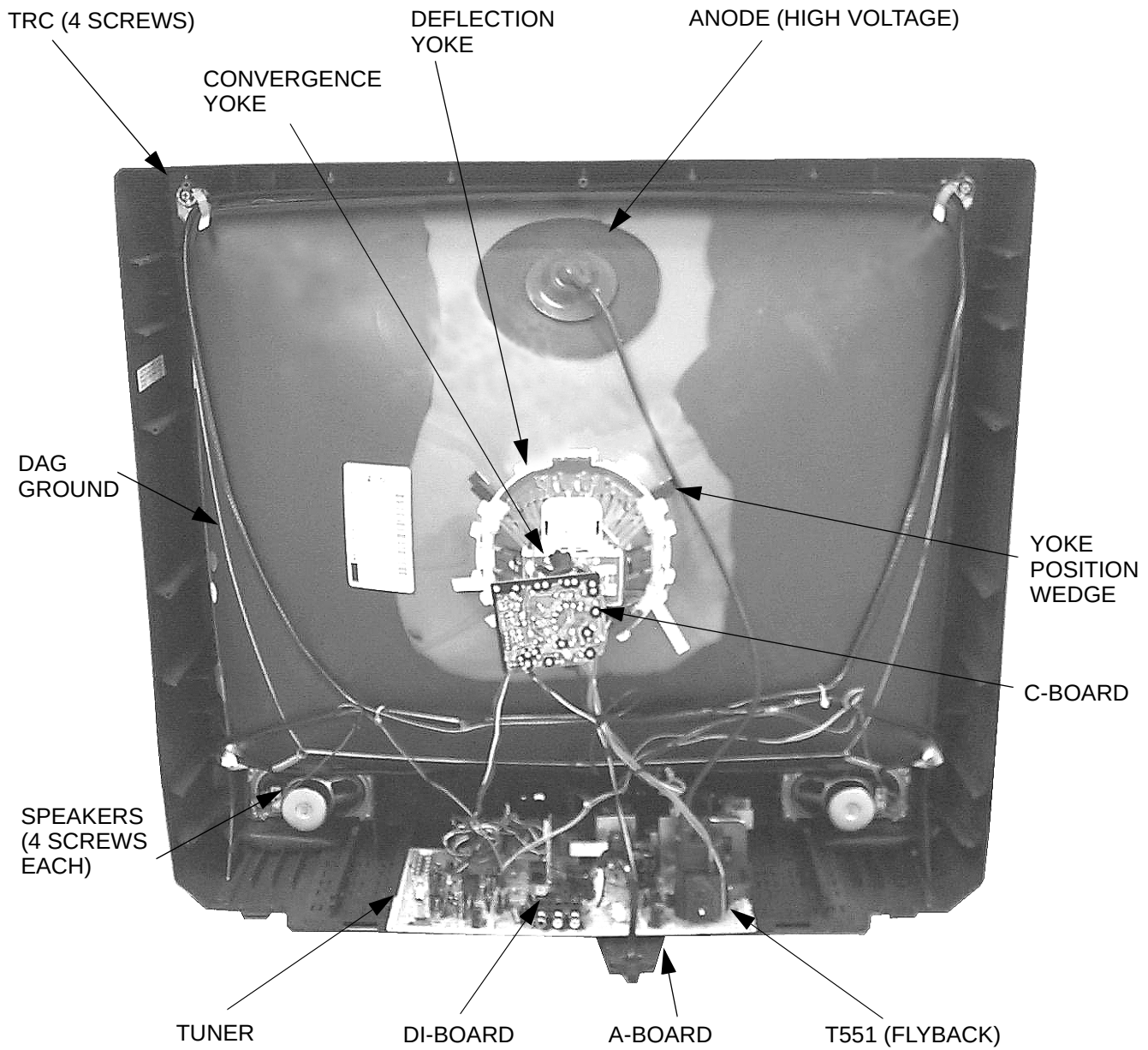


Figure 3. Back Cover Removal.

Note: Screw number may vary depending on model.

Identification of Components



Note: Following the service, remember to dress the cables, as shown above.

Figure 4. Rear View.

Chassis Service Adjustment Procedures

All service adjustments are factory preset and should not require adjustment unless controls and/or associated components are replaced.

Note: Connect the (-) lead of the voltmeter to the appropriate ground. Use IC803's heat sink when the HOT ground symbol (↕) is used. Otherwise, use COLD ground (↗) — Tuner shield, IC451's heat sink or FA2 (Fig. 5, Fig. 6).

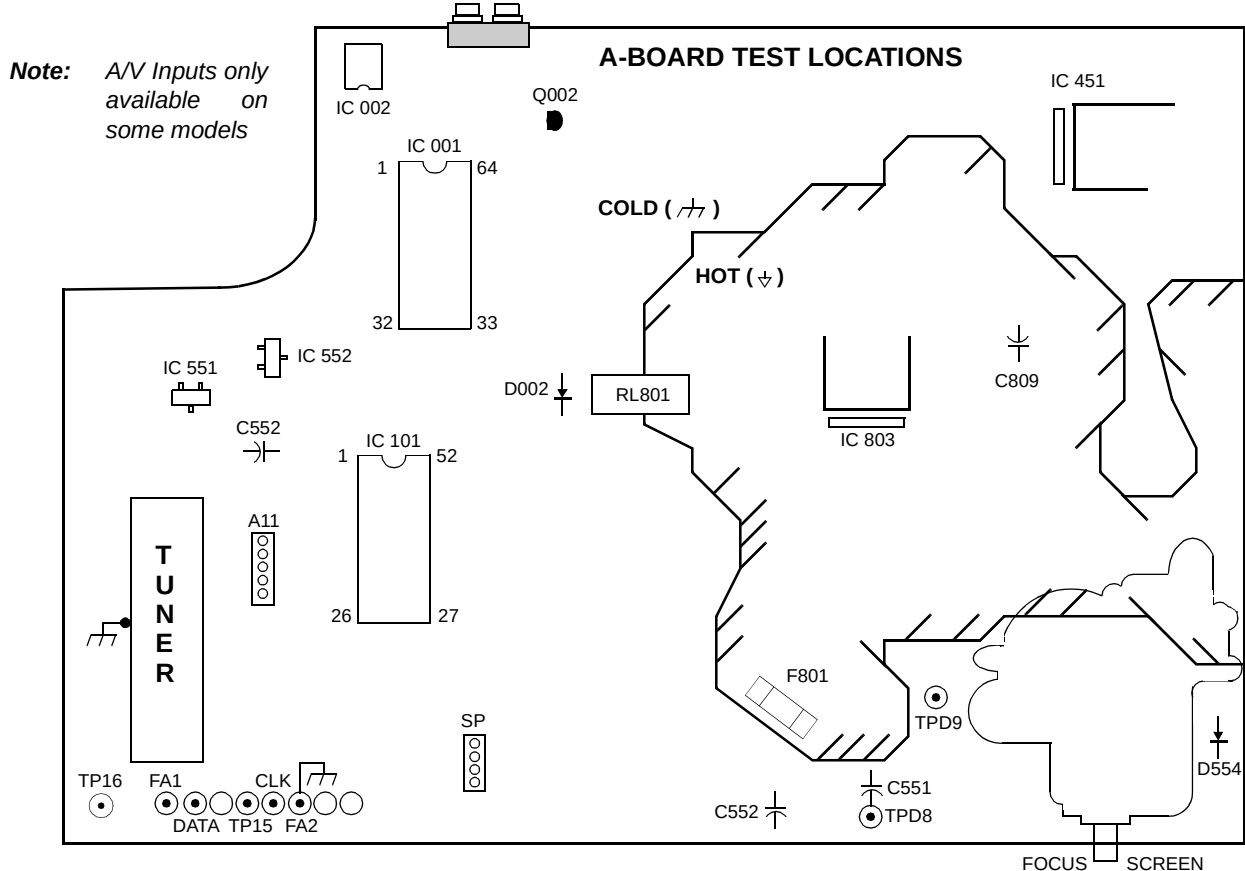


Figure 5. A-Board Main Components and Test Points

MOMENTARILY CONNECT A JUMPER FOR ENTERING SERVICE MODE (FA1 to FA2)

131.0V B+ Voltage Confirmation

1. Set the **Bright** and the **Picture** to Minimum by using the Picture Menu.
2. Connect the DVM between C809(+ side) and hot ground (↕).
3. Confirm that B+ voltage is **131.0V ± 2.5V**. This voltage supplies B+ to the Horizontal Output & Flyback circuits.

Source Voltage Chart

120V AC line input. Set the **Bright** and the **Picture** to Minimum by using the Picture Menu. Use the correct ground for the (-) lead of the DVM.

C809(+)	↕	+131V ± 2.5V
TPD9		+13.0V ± 2V
C552(+)		+20.0V ± 2V (27&25")
		+8.0V ± 1V (32")
TPD8		+27.4V ± 2V
CATHODE OF D554		+220.0V ± 15V (27"&32")
		+220.0V ± 5V (25")

Adjust Picture Menu for normalized video adjustments.

B+ 5V Source Voltages

Volatile 5V:

C572, + side = IC552 pin 3, Tuner BPL, IC101 (IF 5V).

MPU 5V:

Emitter Q002 = IC001 (V_{DD}, AV_{DD}).

Standby 5V:

IC001 (key in 1), I²C EEPROM (IC002), Remote Receiver.

B+ 9V Source Voltage

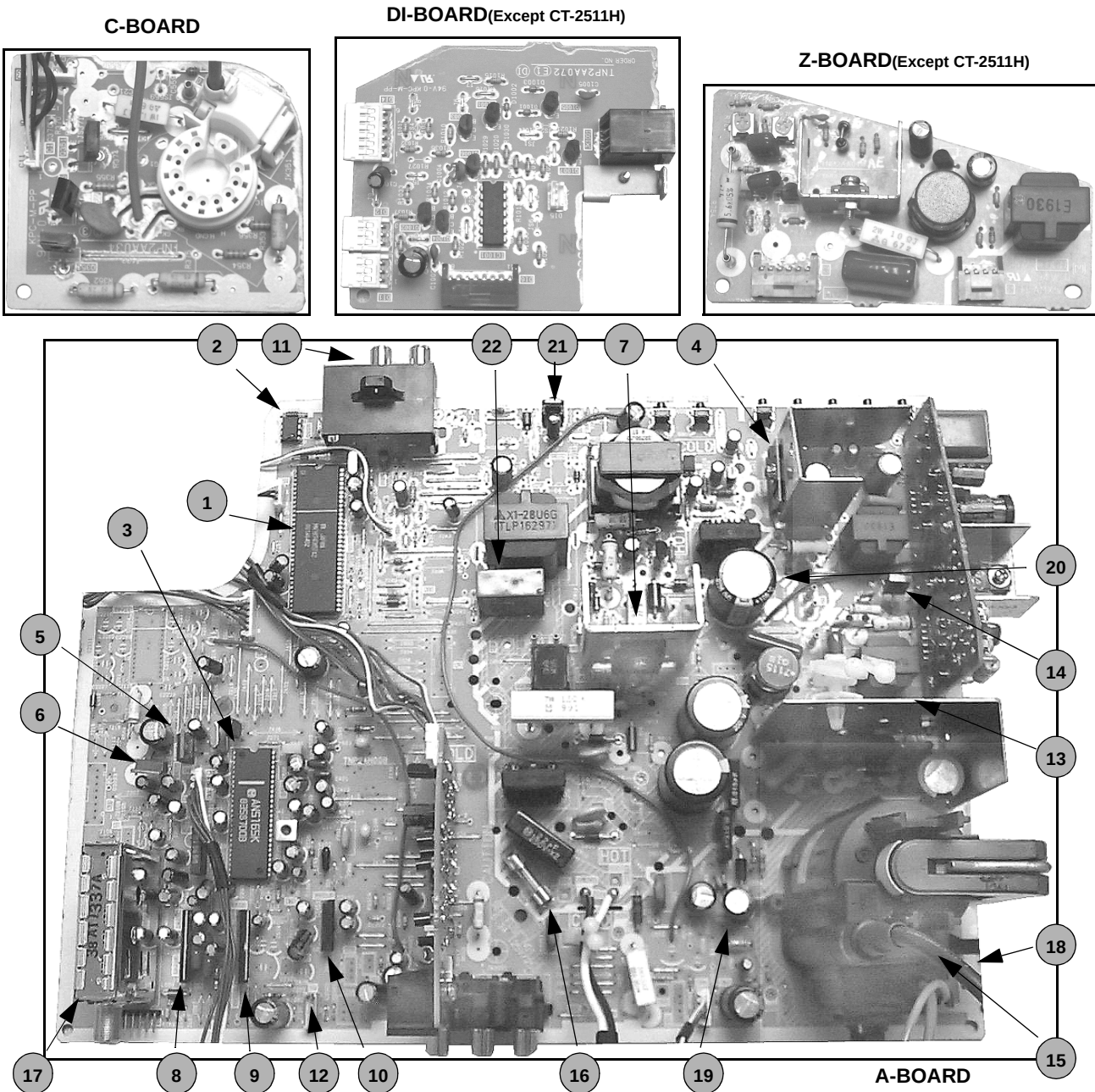
IC551 pin 3 = IC101 (IF 9V), Tuner (BM).

B+ 12V (Stand- by) Note: +16V when power is on
Cathode D002= RL801 (on-off relay).

High Voltage Check

1. Select an active TV channel and confirm that horizontal is in sync.
2. Adjust Brightness and Picture using Picture Icon menu so video just disappears.
3. Confirm B+ 131V is within limit.
4. Using a high voltage meter confirm that the High Voltage is **29.25kV ± 1.25kV**.

Location of Components



No	LOCATION OF COMPONENTS						
ICs		7	IC803	12	SPEAKERS.	17	TUNER
1	IC001 MPU	8	IC2301 AUDIO OUT	13	Q551 HOR.	18	D554
2	IC002	9	IC2302AUDIO OUR	14	Q501	19	C552
3	IC101 VCJ	10	IC2451 SOUND AGC	OTHERS		20	C809
4	IC451VERTICAL	CONNECTORS		15	T551 (FLYBACK)	21	REMOTE SENSOR
5	IC551	11	A/V INPUT (FRONT).	16	FUSE	22	RL801
6	IC552						

Figure 6. View of Boards.

Note: A/V Inputs not available on some models

Purity and Convergence Procedure

Adjustment is necessary only if the CRT or the deflection yoke is replaced or if the setting was disturbed. The complete procedure consists of:

1. Initial static convergence.
2. Setting the purity.
3. Final static convergence.

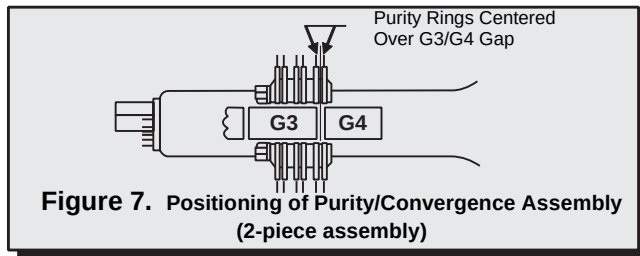
When the CRT or the Yoke is Replaced

Place the yoke on the CRT neck (do not tighten the clamp).

For a 2-piece assembly (Fig. 7):

Position purity/convergence assembly as shown and tighten clamp snugly. Cut the hot-melt glue seal on assembly and place like tabs of purity device together at 12 o'clock to reduce its magnetic field effect. Manually degauss the CRT.

Turn the Receiver ON and slide the deflection yoke back and forth on the neck of the CRT. Stop at the position that produces a near white, uniform raster.



For a 1-piece assembly (Fig. 8):

Place like tabs of purity devices together at 12 O'clock to reduce any magnetic field effect. Manually degauss the set.

Connect a Black/White pattern generator and tune the receiver to the signal. Slide the deflection yoke & purity ring assembly back and forth on the CRT neck. Stop at a position that produces a near white signal.

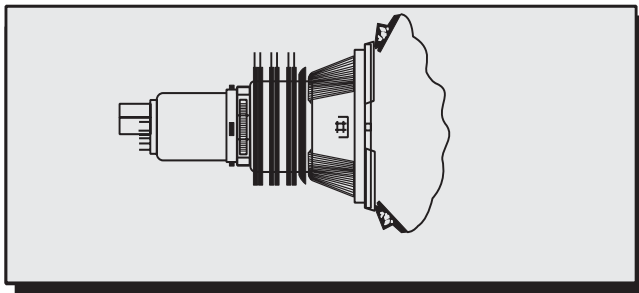


Figure 8. Positioning of Purity/Convergence Assembly (1-piece assembly)

Initial Center Static Convergence

Connect a dot/crosshatch generator to the Receiver and tune in signal. Observe misconvergence at center of the screen only.

Adjust the 4 pole magnet (center rings); separate tabs and rotate to converge blue with red.

Adjust the 6 pole magnet (rear rings): separate tabs and rotate to converge blue and red (magenta) with green.

Note: Precise convergence at this point is not important.

Purity Adjustment

When the Receiver is in the Servicemen Mode for making electronic adjustments, press the **Recall** button on the Remote Control to enter Purity Check. (See **Service Adjustments Electronic Controls.**)

Operate the Receiver for 60 minutes using the first Purity Check field (white screen) to stabilize the CRT.

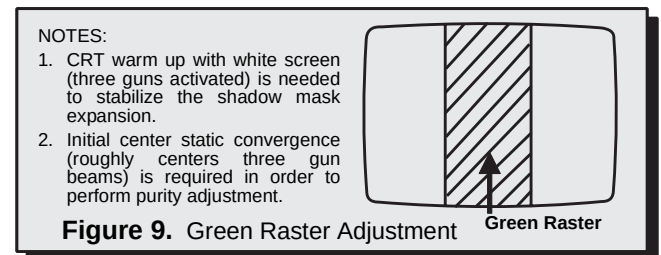
Fully degauss the Receiver by using an external degaussing coil.

Press the **Recall** button on the Remote Control again until the Purity Check (green screen) appears.

For a 2-piece assembly (Fig. 7):

Loosen the deflection yoke clamp screw and move the deflection yoke back as close to the purity magnet as possible.

Adjust the front rings to set the vertical green raster precisely at the center of the screen (Fig. 9).



Slowly move the deflection yoke forward until the best overall green screen is displayed.

For a 1-piece assembly (Fig. 8):

Slowly move the deflection yoke and purity rings assembly toward the CRT board and adjust the purity magnet rings to set vertical green raster at center of screen (see Fig. 9).

Gradually move the deflection yoke & purity rings forward and adjust for best overall green screen.

Continue from here for either assemblies:

Tighten the deflection yoke clamp screw.

Press the **Recall** button on the Remote Control again until the purity check (blue screen) and (red screen) appear and observe that good purity is obtained on each respective field.

Press the **Recall** button on the Remote Control again until Purity check (white screen) appears. Observe the screen for uniform white. If purity has not been achieved, repeat the above procedure.

Final Convergence Procedure

(Fig. 10 through Fig. 12):

Note: Vertical size and focus adjustments must be completed prior to performing the convergence adjustment. Connect a dot pattern generator to the Receiver. The **Brightness** level should not be higher than necessary to obtain a clear pattern.

Converge the red and the blue dots at the center of the screen by rotating the 4 pole (R with B) Static Convergence Magnets.

Align The converged red/blue dots with the green dots at the center of the screen by rotating the 6 pole (R/B with G) Static Convergence Magnets. Melt wax with soldering iron to reseal the magnets.

Slightly tilt vertically and horizontally (do not rotate) the deflection yoke to obtain a good overall convergence. If convergence is not reached at the edges, insert permalloy (see following section) from the DY corners to achieve proper convergence. Recheck for purity and readjust if necessary.

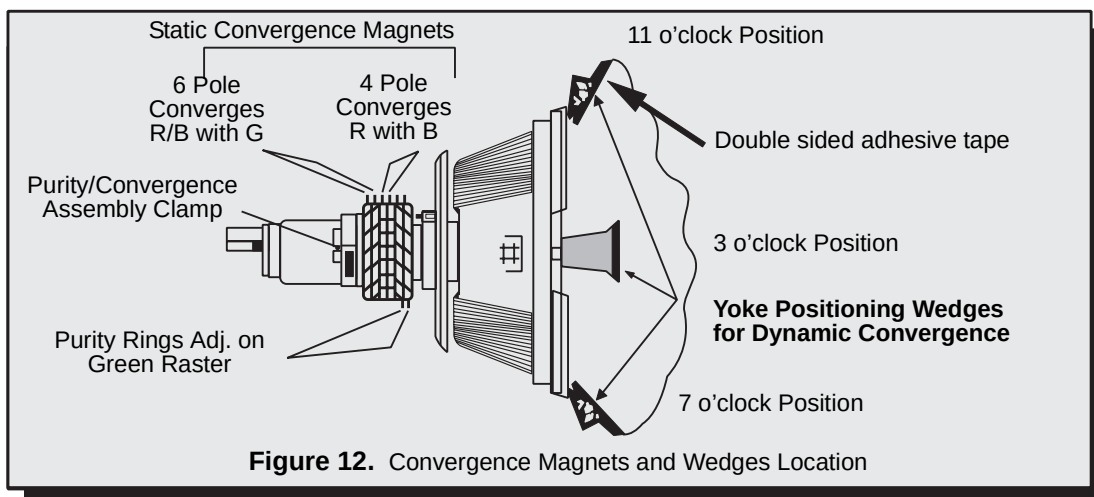
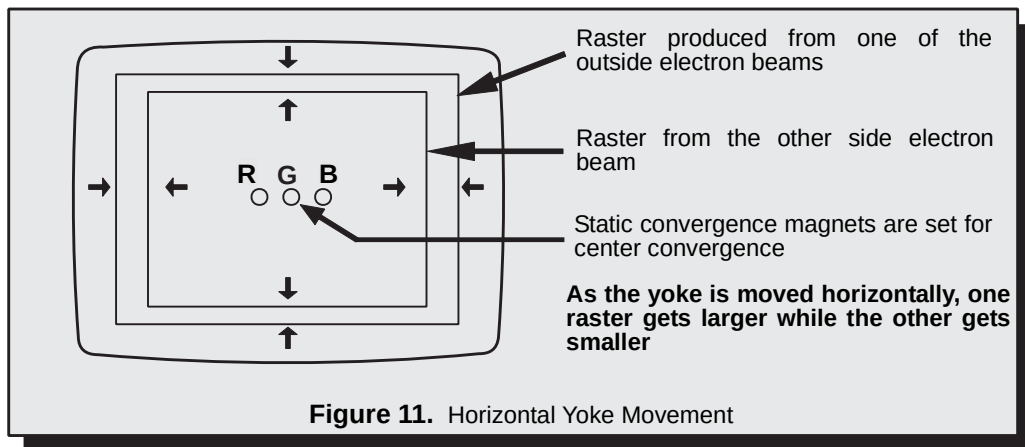
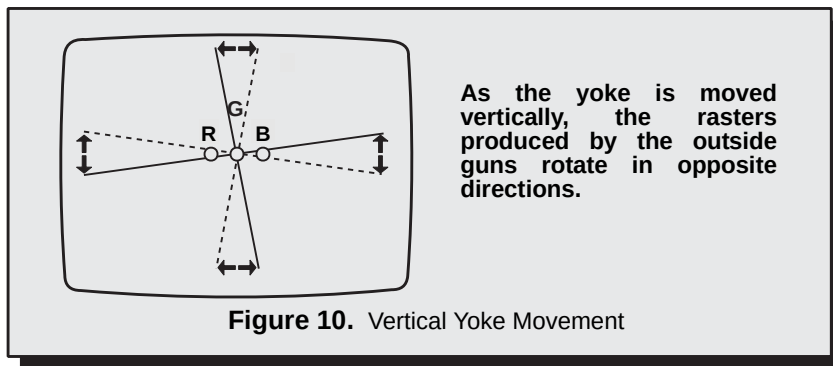
Permalloy Convergence Corrector Strip (Part No. 0FMK014ZZ)

This strip is used in some sets to match the yoke and CRT for optimum convergence. If the yoke or CRT is replaced, the strip may not be required. First converge the set without the strip and observe the corners.

After vertical adjustment of the yoke, insert wedge at 11 o'clock position, then make the horizontal tilt adjustment. Secure the deflection yoke by inserting two side wedges at 3 and 7 o'clock positions. Apply adhesive between tab (thin portion) of wedge and CRT and place tape over the tab to secure to the CRT.

If correction is needed:

1. Place strip between CRT and yoke, in quadrant needing correction. Slowly move it around for desired results.
2. Press adhesive tightly to the CRT and secure with tape.



Serviceman Mode (Electronic Controls)

This Receiver has electronic technology using the I²C Bus Concept. It performs as a control function and it replaces many mechanical controls. Instead of adjusting mechanical controls individually, many of the control functions are now performed by using "On Screen Display Menu". (The **Serviceman Adjustment Mode**.)

Note: It is suggested that the technician reads all the way through and understand the following procedure for Entering/Exiting the **Serviceman Adjustment Mode**; then proceed with the instructions working with the Receiver. When becoming familiar with the procedure, the Flow Chart for Serviceman Mode may be used as a quick guide.

Quick Entry to Serviceman Mode:

At times when minor adjustments need to be done to the electronic controls, the method of Entering the serviceman Mode without removal of the cabinet back is as follows using the Remote Control:

1. Select SET-UP icon and select CABLE mode.
2. Select TIMER icon and set SLEEP time for 30 Min.
3. Press ACTION button twice to exit menus.
4. Tune to the Channel 124.
5. Adjust VOLUME to minimum (0).
6. Press the VOL ◀ button (decrease) on Receiver. Red "CHK" appears in upper corner.

To toggle between Aging and Serviceman modes:

While the "CHK" is displayed on the left top corner of the CRT, pressing the Action and the Volume Up buttons on the Receiver simultaneously will toggle between the modes. Red "CHK" for Serviceman and yellow "CHK" for Aging.

7. Press the **Power** Button on the **Remote Control** to select one of six Serviceman Adjustment Modes.
 - 1) **B**= Serviceman VCJ SUB-DATA ADJUSTMENT.
 - 2) **C**= Serviceman VCJ CUT-OFF ADJUSTMENT.
 - 3) **S**= Serviceman OPTIONS (PIP and CLOCK) ADJUSTMENT.
 - 4) **M**= Serviceman MTS ADJUSTMENTS.
 - 5) **X** = Serviceman COMB FILTER ADJUSTMENT.
 - 6) **"CHK"** = Normal operation of CHANNEL ▲▼ and VOLUME ◀▶.

Note: Only the applicable settings for the Receiver serviced will be available (See **a** in Fig. 13).

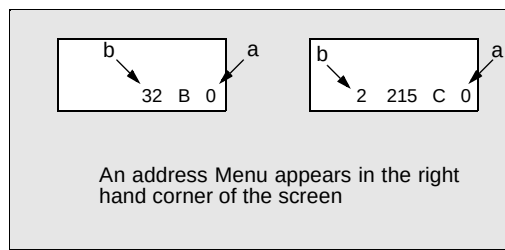


Figure 13. Serviceman Mode Menu Adjustments.

Exiting the Serviceman Mode:

Press the **Action** and the **Power** buttons on the **Receiver** simultaneously for at least 2 seconds.

THE RECEIVER EXITS SERVICEMAN MODE.

The Receiver momentarily shuts off; then comes back on tuned to channel 3 with a preset level of sound. Any programmed channels, channels caption data and some others user defined settings will be erased.

IMPORTANT NOTE:
Always Exit the Serviceman Mode
Following Adjustments.

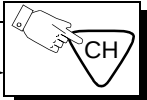
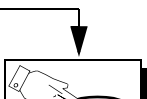
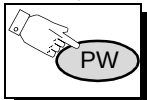
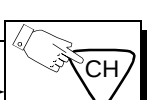
Press the **Power Button** on the **Remote Control** to select the Serviceman Adjustment.

For Adjustments:

1. Press **Channel Up/Down** on the **Remote Control** to select one of the available Service Adjustments (**a** in Fig. 13).

Note: Write Down the original value set (**b** in Fig. 13) for each address before modifying anything. It is easy to erroneously adjust the wrong item.

2. Press **Volume Up/Down** on the **Remote Control** to adjust the level of the selected Service Adjustment (**b** in Fig. 13).

Sub-Data Adjustment		Adj. Range	Default Level	
B0	SUB-COLOR	0 ~ 63	24	
B1	SUB-TINT	0 ~ 63	45	
B2	SUB-BRIGHTNESS	0 ~ 255	75	
B3	SUB-PICTURE	0 ~ 63	31	
B4	KILLER/ABL/GAMMA	0 ~ 7	5	
B5	VIDEO ADJUSTMENT	0 ~ 15	8	
B6	AUDIO ADJUSTMENT	0 ~ 31	16	
B7	V-SIZE	0 ~ 63	37	
Cut-Off Adjustment		Adj. Range	Default Level	
C0	CUT-OFF R	0 ~ 1 0 ~ 255	0 127	
C1	CUT-OFF G	0 ~ 255	64	
C2	CUT-OFF B	0 ~ 1 0 ~ 255	0 100	
C3	DRIVE R	0 ~ 127	67	
C4	DRIVE B	0 ~ 127	64	
C5	YNR SWITCH	0 ~ 1	0	
C6	AFT	0 ~ 1 0 ~ 255	1 103	
C7	RF-AGC	0 ~ 127	64	
C8	YNR VIDEO ADJUSTMENT	0 ~ 7	0	
C9	HORIZONTAL CENTER	0 ~ 31	12	
Ca	BEAM LIMIT	0 ~ 7	4	
Cb	VCJ TEST H	0 ~ 2	2	

IMPORTANT NOTE:
Always Exit the Serviceman Mode Following Adjustments.

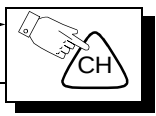
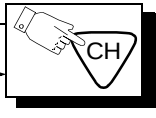
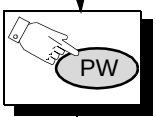
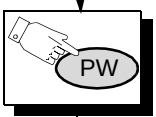
Press the Power Button on the Remote Control to select the Serviceman Adjustment

For Adjustments:

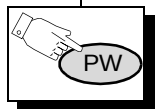
1. Press Channel Up/Down on the Remote Control to select one of the available Service Adjustments (See **a** in Fig. 13).

Note: Write Down the original value set (**b** in Fig. 13) for each address before modifying anything. It is easy to erroneously adjust the wrong item.

2. Press Volume Up/Down on the Remote Control to adjust the level of the selected Service Adjustment (See **b** in Fig. 13).

Options Adjustment		Adj. Range	Default Level	
S0	PIP COLOR	0 ~ 127	80	
S1	PIP CONTRAST	0 ~ 127	52	
S2	UP 1/9	0 ~ 255	26	
S3	DOWN 1/9	0 ~ 255	146	
S4	LEFT 1/9	0 ~ 255	9	
S5	RIGH 1/9	0 ~ 255	103	
S6	UP 1/16	0 ~ 255	27	
S7	DOWN 1/16	0 ~ 255	163	
S8	LEFT 1/16	0 ~ 255	9	
S9	RIGH 1/16	0 ~ 255	118	
Sa	FREERUN	N/A	N/A	
Sb	CLOCK ADJUSTMENT	0 ~ 255	128	
Sc	PIP TINT	0 ~ 63	50	
Sd	LOUDNESS COMPENSATION	0 ~ 63	2	
MTS Adjustment		Adj. Range	Default Level	
M0	INPUT LEVEL	0 ~ 63	31	
M1	HIGH-LEVEL SEPARATION	0 ~ 63	31	
M2	LOW-LEVEL SEPARATION	0 ~ 31	31	

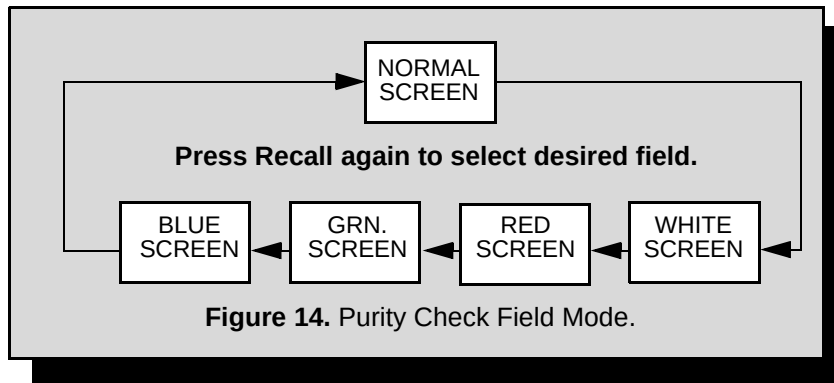
To B Items.



IMPORTANT NOTE:
Always Exit the Serviceman Mode Following Adjustments.

To Check Purity:

Press the **Recall** Button on the **Remote Control** when in Serviceman Mode (red “CHK” is displayed) to enter the Purity Field Check Mode.



Helpful Hints

Entering Serviceman Mode (Back-Open Method)

1. While the Receiver is ON and operating in Normal Mode, momentarily short test point **FA1** (TP8) to Cold Ground ($\nearrow$) **FA2** (TP3) A-Board.

The Receiver enters the Aging Mode.

Yellow letters “CHK” appear in the upper left corner of the CRT.
(The Volume Up/Down will adjust rapidly).

2. Simultaneously press the **Action** and the **Volume Up** buttons on the **Receiver** Control Panel.

The Receiver enters the Serviceman Mode.

The letter in “CHK” turn red.

(The Volume Up/Down will adjust normally).
(All costumer controls are set to nominal level).

IMPORTANT NOTE:
Always Exit the Serviceman
Mode Following Adjustments.

Instructional Flow Chart for Serviceman Mode

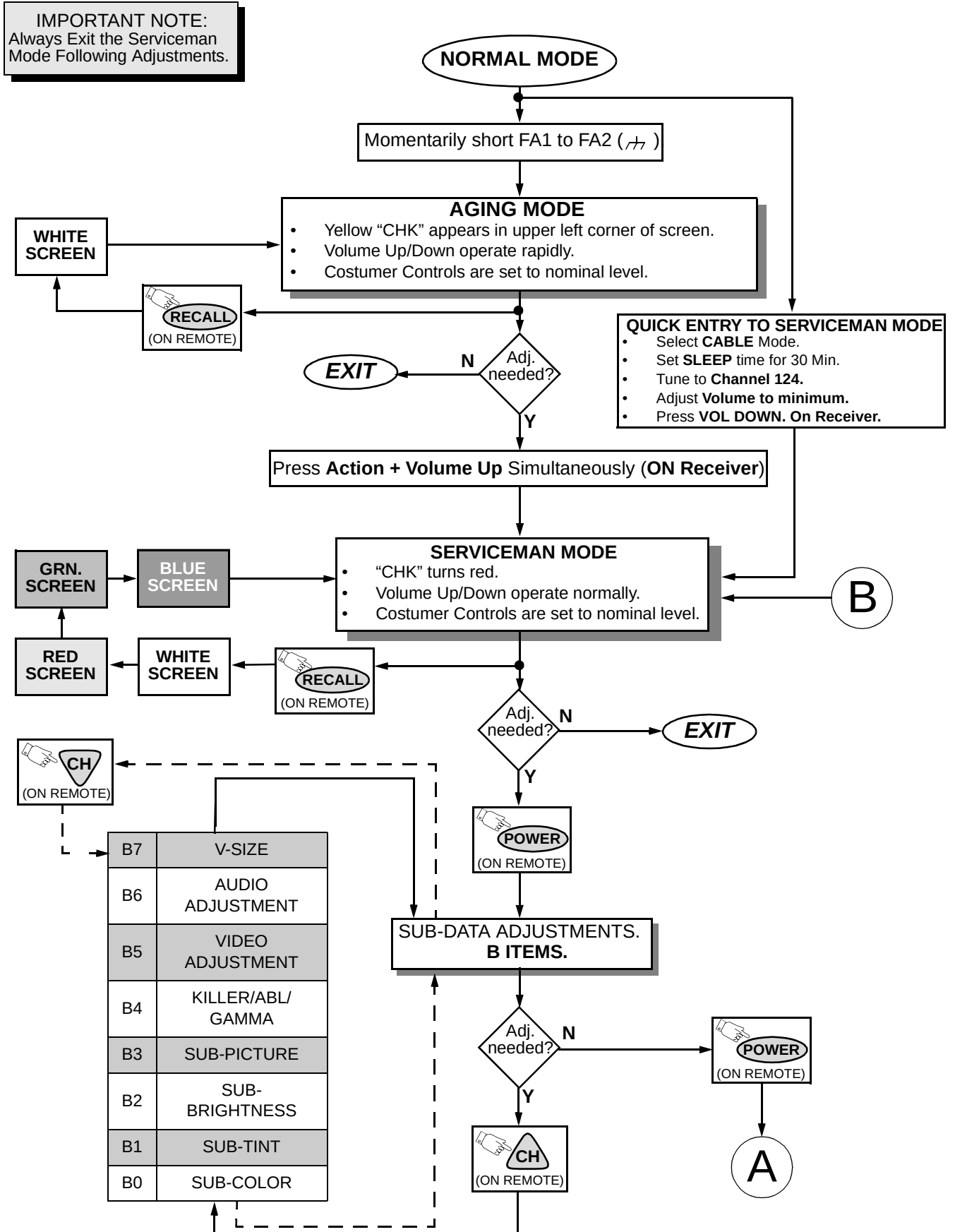


Figure 15. Flow Chart for Serviceman Mode.

Instructional Flow Chart for Serviceman Mode - Continued

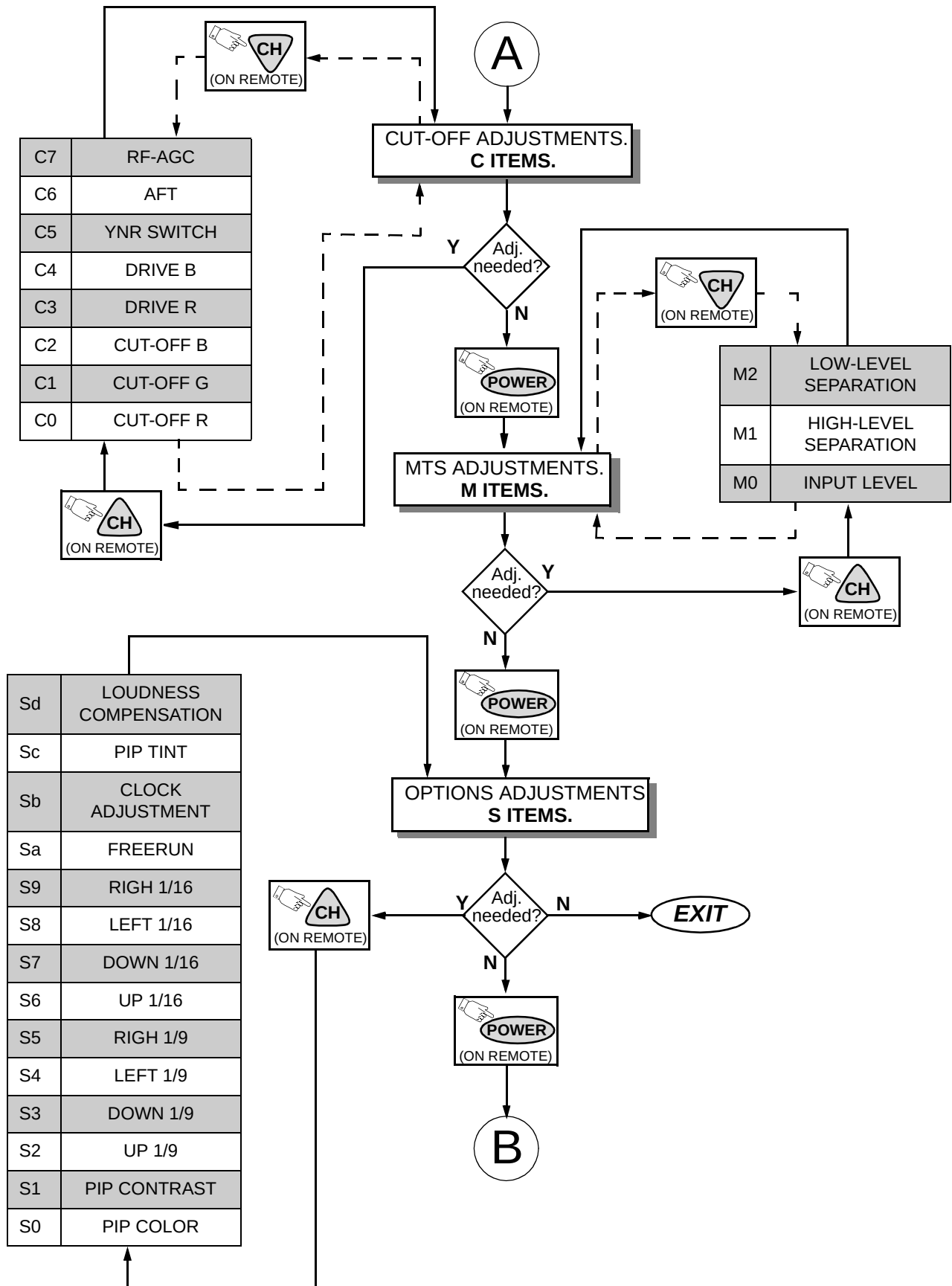


Figure 16. Flow Chart for Serviceman Mode (Continued).

Service Adjustments (Electronic Controls)

Sub-Brightness

Serviceman DAC Adjustment (B2)

Adjustment of this control is important for setting proper operation of customer brightness and picture controls. This adjustment must be made after Sub-Contrast or Color Temperature adjustments are made. **Do not adjust** SCREEN after the Sub-Brightness is set.

Preparation:

1. Apply a color bar signal with 100 IRE white and 7.5 IRE black. (Switch Color to "OFF" on the signal generator.) Operate the Receiver for a minimum of 10 minutes prior to performing this adjustment.

Procedure:

In the Serviceman Mode for making electronic adjustments, select the DAC adjustment (B2) and adjust until the black starts to look gray. Then decrease the level to the point where gray turns to black.

Note: You may set the accurate value following the preparation steps and the procedure step No. 2 of the Sub-Contrast adjustment described below.

Video Adjustment Level

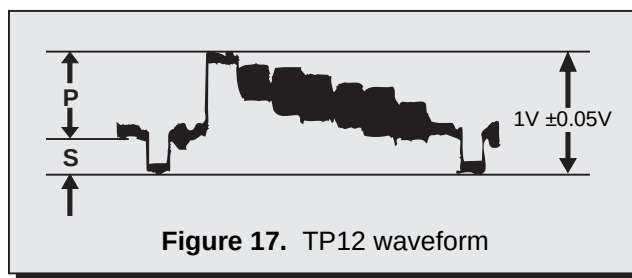
Serviceman DAC Adjustment (B5)

Preparation:

1. Obtain an NTSC color bar pattern with 100 IRE white and 87.5% modulation.
2. Connect the oscilloscope to TP12. Use cold ground for scope connection. Set the scope at Horizontal Sweep rate (20 μ s) time base.

Procedure:

1. In the Serviceman Mode for making electronic adjustments, select DAC Video Adjustment Level (B5) and adjust for 1V from sync tip to white level. Fig. 17.



2. Check that the sync signal amplitude (ratio between the sync signal to detection output) is within the range of 30 $\pm$ 5% ($S/(S+P) = 30 \pm 5\%$).
3. Set the DAC Sub-Contrast Adjustment (B3).

Sub-Contrast

Serviceman DAC Adjustment (B3)

This adjustment is factory set. **Do not adjust** unless repairs are made to associated circuit, the CRT Board or when the CRT is replaced.

Preparation:

1. Apply a color bar signal pattern with 87.5% modulation, 70% saturated color bar with a 100 IRE white and 7.5 black.

Note: The pattern used in this procedure is an EIA color bar pattern with 87.5% modulation with 100 IRE white and 7.5 black. Correlate the information in this procedure to the pattern used if another signal is used.

2. Preset the following controls:

- Brightness Center.
- Color Min.
- Picture Max.
- Sharpness Center.

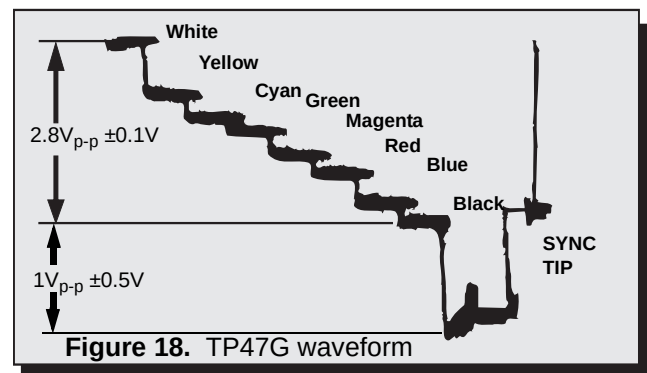
3. Connect the oscilloscope to the CRT-Board connector C1-2. Set the scope time base to 20 μ s (horizontal).

4. Connect a jumper from TPD2 to ground ($\nearrow$).

5. Connect a jumper from IC101 pin 28 to ground ($\nearrow$).

Procedure:

1. In the Serviceman Mode for electronic adjustments, select DAC Sub-Contrast Adjustment (B3) and adjust for 2.8Vp-p $\pm$ 0.1V from white level to black level on video waveform. (Fig. 18).



2. In the Serviceman Mode, select DAC Sub-Brightness Adjustment (B2) and adjust for 1.0-1.5Vp-p between blanking and 7.5 IRE level. (Fig. 17).
3. Remove the jumpers (Preparation steps 4 & 5).

Tint/Color Adjustment

Serviceman DAC Adjustment (B1) (B0)

Preparation:

1. Apply a rainbow color bar signal.

2. Preset the following controls:

- Brightness Min.
- Color Center.
- Tint. Center.
- Picture Max.
- Sharpness Min.

3. Connect the oscilloscope to TP47B (A-Board).

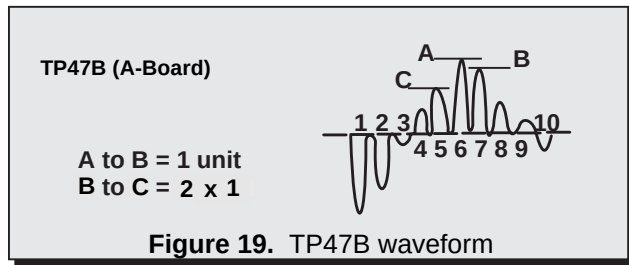
4. Connect a jumper from TPD2 to GND ($\nearrow$).

5. Connect a jumper from IC101 pin 28 to ground ($\nearrow$).

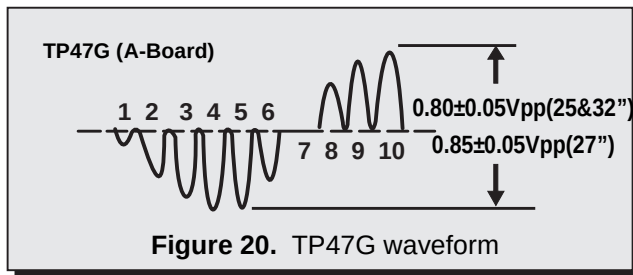
Service Adjustments (Electronic Controls, cont.)

Procedure:

1. In the Serviceman Mode for making electronic adjustments, select DAC Sub-Tint Adjustment (B1). Adjust until the waveform measured is as the one shown in Fig. 19.



2. Connect the oscilloscope to TP47G (A-Board).
3. Select DAC Sub-Color Adjustment (B0) and adjust for peak to peak amplitude to be as shown in Fig. 20.



4. Remove the jumpers (Preparation steps 4 & 5).

Color Temperature Adjustment (B/W Tracking)

Serviceman DAC Adjust. (C1) (C2) (C3) (C4) (C5) Minor Touch-Up Method

OBSERVE low and high brightness areas of a B/W picture for proper tracking. Adjust only as required for "good gray scale and warm highlights".

1. LOW LIGHT areas – In Serviceman Mode for making electronic adjustments, select Cutoff (C0) RED, (C1) GRN, (C2) BLU and adjust the picture for gray.
2. HIGH LIGHT areas – In Serviceman Mode for making electronic adjustments, select Drive (C3) RED, (C4) BLU and adjust the picture for warm whites.

Complete Adjustment

Preparation:

1. Turn the Receiver "ON" and allow 10 minutes warm up at high brightness.
2. Apply a color bar signal with color "OFF".
3. Turn the SCREEN control (part of FBT T551) fully counterclockwise.

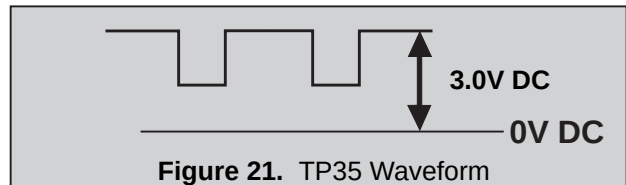
Procedure:

Preset the following Serviceman DACs for best results:

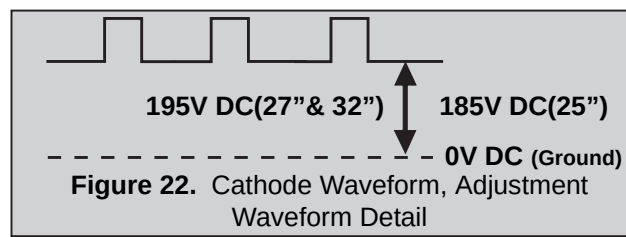
- C0..... 0 128
- C1..... 64
- C2..... 0 128
- C3..... 64
- C4..... 64

1. Connect the oscilloscope to C1-2 (CRT-Board). - 22 -

2. In Serviceman Mode for making electronic adjustment, select the Sub-Bright DAC (B2).
3. Press the R-Tune key on the remote.
4. Observe the oscilloscope waveform at Horizontal rate and adjust the Serviceman Mode Sub-Bright DAC (B2) level until a scanning period of 3.0V above DC ground is measured, as indicated in Fig. 21.



5. Connect the scope to GRN Cathode (KG) on the CRT-Board.
6. In the Serviceman Mode for making electronic adjustments, select the GREEN CUTOFF DAC (C1).
7. Press the R-Tune key on the remote.
8. View scope trace at Horizontal rate and adjust the Serviceman Mode DAC (C1) level until a scanning period of voltage above DC ground is measured, as indicated in Fig. 22.



9. Connect the scope to the RED Cathode (KR).
10. In Serviceman Mode for making electronic adjustments, select the RED CUTOFF DAC (C0).
11. Press the R-Tune key on the Remote
12. View the scope trace and adjust the Serviceman Mode DAC (C0) for the scanning period to be 195V for 27" & 32" and 185V for 25" above DC ground. (Fig. 22)
13. Connect the scope to the BLUE Cathode (KB).
14. In Serviceman Mode for making electronic adjustments, select the BLUE CUTOFF (C2).
15. Press the R-Tune key on the Remote.
16. View the scope trace and adjust the Serviceman Mode DAC (C2) for the scanning period to be 27" & 32" and 185V for 25" above DC ground. (See Fig. 22)
17. Turn the Screen Control (part of FBT) slowly clockwise until a color horizontal line appears.
18. With the other two colors Serviceman Mode DAC CUTOFF adjustments (C0) RED, (C2) BLUE; increase the colors to create a white horizontal line.
19. Confirm that a good gray scale is established by viewing B/W color bar pattern.
20. In the Serviceman Mode for making electronic adjustments select the DAC DRIVE adjustments (C3) RED, (C4) BLUE and adjust for warm white in a white color bar pattern.

Service Adjustments (Electronic Controls, cont.)

21. EXIT the Serviceman Mode.
22. Adjust the Picture Menu Video Adjustments **Bright** and **Picture** from low scale to high scale and check Black and White tracking.
23. If correction is needed: Re-Enter the Serviceman Mode and perform the **Minor Touch – Up Method**.
24. Perform **Sub-Brightness** Adjustment procedure if needed.

Horizontal Centering

Serviceman DAC Adjustment (C9)

Preparation:

Connect a crosshatch generator.

Procedure:

1. In the Serviceman Mode for making electronic adjustments. Select the Horizontal Centering Adjustment DAC (C9) and adjust until the center of the crosshatch pattern is centered on CRT.
2. EXIT the Serviceman Adjustment Mode.

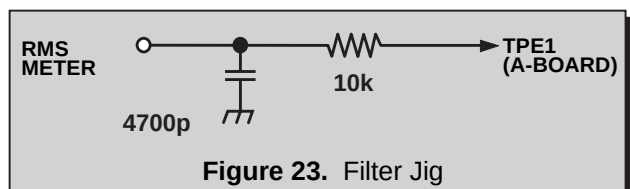
Audio Adjustment

Serviceman DAC Adjustment (B6)

This adjustment is factory set and needs to be performed only when IC002 or IC101 is replaced.

Preparation:

1. Apply the following signal at the antenna (70dB $\pm$ 5dB, 75 Ω open P/S 10dB): audio signal set to monaural, 300Hz. 100% modulation; video input of 100 IRE flat field, 30% modulation.
2. Connect the RMS Meter with filter jig as shown in Fig. 23.



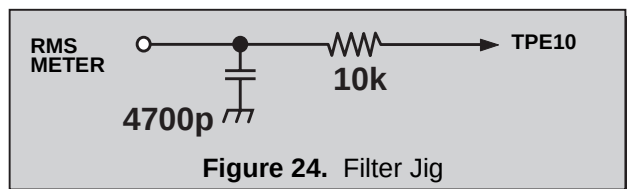
Procedure:

1. In the Serviceman Mode for making electronic adjustments, select the Audio Adjustment DAC (B6) and adjust until 350mV $\pm$ 12.5mV RMS is measured.
2. EXIT the Serviceman Adjustment Mode.

Input Level Adjustment (M0)

Preparation:

1. Connect an RMS meter with filter jig as shown in Fig. 24.



2. Connect an RF signal generator to the RF antenna input.

Procedure:

1. Apply the following signal from the RF signal generator:
Video: 100 IRE flat field, 30% modulation.
Audio: 300Hz, 100% modulation, monaural (70 $\pm$ 5dB, 75 Ω OPEN, P/S 10dB).
2. Adjust the MTS Input Level Adjustment (M0) until the voltage measured is 212 $\pm$ 10.5mVrms.

Service Adjustments (Electronic Controls, cont.)

Clock Adjustment (Sb)

Preparation:

Connect the frequency counter from TPS1 (IC001 Pin 13) to cold ground ($\rightarrow$).

Note: Frequency Counter probe capacitance should be 8pF or less.

Procedure:

1. Turn the Receiver "OFF" with the AC power applied.
2. Measure TPS1 (IC001 pin 13) for the frequency of the waveform and record the reading.

Note: Pin 13 measurement must have at least four digits of resolution following the decimal point.
Example: 000.0000

3. Turn the Receiver back "ON".
4. Place the Receiver into Serviceman Mode for making electronic adjustment, select the Clock Adjustment DAC (Sb).

5. Calculate and set Sb based on the following formula:

$$Sb = 128 + 0.901 \times 10^6 \frac{244.1406 - pin13[Hz]}{244.1406}$$

Note: Pin 13 measurement will not change regardless of the value stored in Sb.

Vertical Size (B7)

1. Adjust the VERTICAL SIZE DAC control, B7, until the top and the bottom edges of the raster are visible.
2. Adjust the VERTICAL SIZE control, B7, until the top and the bottom of the raster touch the bezel edge. The advance SIZE control to obtain an approximately 10% overscan. Linearity adjustment is don automatically when the size is being adjusted. (Best results can de obtained with a round test patter.)

Service Adjustments (Mechanical Controls)

VCO Field Alignment L105 (IC101 pins 35 & 36)

1. Connect a balance antenna and select a midband channel (Ch 10, 11 or 12)
2. Attenuate the signal strength for a weak noisy video.
3. While observing the picture tube, adjust L105 until best picture appears.
4. Change channels and observe that they are tuning properly.
5. If the channel monitored is not clear, repeat steps 1, 3 and 4 while applying a stronger signal.

Focus (T551)

Preparation:

Connect a Signal generator and select a dot pattern.

Procedure:

Adjust the FOCUS control to obtain the sharpest and clearest dot pattern.

- a. Adjust for best center.
- b. Adjust for best area between the center and top right corner.

Hotel Mode Feature

This models have as a main feature the Hotel Mode, this mode allows to program the receiver with exactly the same settings than other TV, using a “Clone Box”. (Only models with Digital interface).

Clone Box Use

The clone box uploads (LEARN) the settings of one television and downloads (TEACH) them to other televisions. This places the television into Commercial (Hotel) Mode.

Note: *The Clone Box is not supplied with the set. It can be purchased separately.*

Setting the “Master” Television

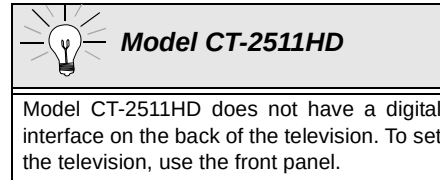
The features listed in the Commercial (Hotel) Mode table must be adjusted before cloning can begin.

1. Turn the television ON.
2. Access the Main Menu by pressing the **ACTION** button.
3. Access the Set Up menu.
 - Use the **CH** and **VOL** buttons to highlight the Set Up icon, then press the **ACTION** button.
 - Use the **CH** buttons to highlight AUTO PROG (Auto Channel Programming), then press the **VOL** button to begin programming.

Note: *This step is mandatory.*

- If necessary, use MANUAL PROG (Manual Channel Programming) to delete any undesired channels.
 - Press the **ACTION** button to return to the Main Menu.
4. If necessary, access the Picture menu.
 - Use the **CH** and **VOL** buttons to highlight the Picture icon, then press the **ACTION** button.
 - Use the **CH** buttons to highlight a feature, then press the **VOL** buttons to adjust them.
 - Press the **ACTION** button to return to the Main Menu.
 5. If desired, access the Channel Caption menu.
 - Use the **CH** and **VOL** buttons to highlight the Ch Cap icon, then press the **ACTION** button.
 - Use the **CH** buttons to highlight the channel number, then press the **VOL** buttons to select characters for the channel caption.
 - Press the **ACTION** button to return to the Main Menu.

6. Exit the Main Menu by pressing the **ACTION** button.
7. If necessary, set the maximum volume level.
8. If the hotel has hotel “barker” channel, tune the set to the “barker” channel.



IMPORTANT

When the set is in Stand-Alone (SA) hotel mode, (No digital interface connected to TV) The menu screen can only be accessed using the ACTION button on the Panasonic remote control.

When the set is in Slave-to-Mate (STM), hotel mode (Using the digital interface) the menu screen can be accessed only using the Hotel remote control.

Uploading Television Settings into the Clone Box (LEARN)

1. Press the **POWER ON** button on the clone box.
 - The LEDs will flash red and green to confirm power is ON.
2. Connect the clone box to the Digital Interface port on the back of the television.
 - The television must be plugged into an AC outlet but can be either OFF or ON.
3. Hold the **ALT** button while pressing the **LEARN** button.
 - The red LED will flash while the data is uploaded to the box. The green LED will light for about two (2) seconds when the procedure is complete.

Note: *The television is now in Commercial (Hotel) Mode.*

4. Disconnect the clone box from the television and turn it OFF.

Note: *This will not affect the data stored in the box as long as the battery is inserted and charged.*

Downloading Settings into Other Televisions (TEACH)

1. Press the **POWER ON** button on the clone box.
 - The LEDs will flash red and green to confirm power is ON.
2. Connect the clone box to the Digital Interface port on the back of the television.
 - The television must be plugged into an AC outlet but can be either OFF or ON.
3. Press the **TEACH** button.
 - The green LED will flash while data is downloaded to the television. The green LED will light for about two (2) seconds when the procedure is complete.

Note: *The television is now in Commercial (Hotel) Mode.*
4. Disconnect the clone box from the television and turn it OFF.
5. Repeat steps 1 – 4 to set up other televisions.

Setting Individual Volume Limits

This procedure allows the maximum volume level to be changed on individual televisions.

For lower volume

The television must be in Commercial (Hotel) mode.

1. Turn television ON.
2. Adjust the television volume to desired level.

Note: *This will become the new maximum volume level.*
3. Press the **POWER ON** button on the clone box.
 - The LEDs will flash red and green to confirm power is ON.
4. Connect the clone box to the Digital Interface port on the back of the television.
5. Hold the **ALT** button while pressing the **LEARN** button on the clone box.
 - The red LED will flash while the data is uploaded into the box. The green LED will light for about two (2) seconds when the procedure is complete.
6. Disconnect the clone box from the television and turn it OFF.

7. Reset the volume on the television.
8. Refer to the section entitled *Setting Up Other Televisions Using the Clone Box (TEACH)*

For higher volume

The television must be in Normal TV mode. Refer to the section entitled *Resetting the Television to Normal TV mode.*

1. Turn television ON.
2. Adjust the television volume to the minimum setting.
3. Press the **POWER ON** button on the clone box.
 - The LEDs will flash red and green to confirm power is ON.
4. Connect the clone box to the Digital Interface port on the back of the television.
5. Adjust the television volume to maximum desired level.
6. Hold the **ALT** button while pressing the **LEARN** button on the clone box.
 - The red LED will flash while the data is uploaded into the box. The green LED will light for about two (2) seconds when the procedure is complete.
 - If the green LED does not light for about two (2) seconds, retry by holding the **ALT** button while pressing the **LEARN** button.
7. Disconnect the clone box from the television and turn it OFF.
8. Reset the volume on the television.
9. Refer to the section entitled *Setting Up Other Televisions Using the Clone Box (TEACH)*.

IMPORTANT

When the set is in Stand-Alone (SA) hotel mode, (No digital interface connected to TV) The menu screen can only be accessed using the ACTION button on the Panasonic remote control.

When the set is in Slave-to-Mate (STM), hotel mode (Using the digital interface) the menu screen can be accessed only using the Hotel remote control.

Testing the Settings in the Clone Box

This test compares the clone box settings with the television settings. The television must be in Commercial (Hotel) mode.

1. Press the **POWER ON** button on the clone box.
 - The LEDs will flash red and green to confirm power is ON.
2. Connect the clone box to the Digital Interface port on the back of the television.
 - The television must be plugged into an AC outlet but can be either OFF or ON.
3. Press the **TEST** button.
 - The LEDs will flash red and green while the data is compared. The green LED will light for about two (2) seconds if the settings in the box match the television.
4. Disconnect the clone box from the television and turn it OFF.

Testing the Clone Box Battery

1. Press the **POWER ON** button on the clone box.
 - The LEDs will flash red and green to confirm power is ON.
2. Hold the **ALT** button while pressing the **TEST** button.
 - The LEDs will alternately flash red and green while the box is tested.

Note: *Replace the 9 volt battery if the LEDs do not flash red and green.*

- The green LED will light for about two (2) seconds, if battery is charged.

Note: *If the green LED does not light for about two (2) seconds at the end of the test, new data must be downloaded into the box.*

Resetting the Television to Normal TV Mode

1. Press the **POWER ON** button on the clone box.
 - The LEDs will flash red and green to confirm power is ON.
2. Connect the clone box to the Digital Interface port on the back of the television.
 - The television must be plugged into an AC outlet but can be either OFF or ON.
3. Press the **AMS** button.

Note: *Insert a slender tool about 3/4 inch (paper clip) into the opening.*

 - The green LED will flash while the television is reset to Normal TV mode. The green LED will light for about two (2) seconds when the procedure is complete.
4. Disconnect the clone box from the television and turn it OFF.
5. Press the **ACTION+POWER** buttons on the front of the set for 5 seconds to complete the change to normal TV mode. The receiver momentarily shuts off; then comeback on tuned to channel 3 with a preset level of sound and display the self-check screen. Any programed channel and other user defined settings will be lost, except channel caption.

Switching to Commercial (Hotel) Mode

Adjust the features listed in the Commercial (Hotel) Mode Feature Chart before switching modes.

1. Press the **ACTION** (6*) button and the **VOL ►** (3) button simultaneously.
2. Within a second, press the **ACTION** (6) button and the **CH ▲** (5) button simultaneously.
3. ON will flash in red in the lower corner of the screen, indicating Commercial (Hotel) Mode.

Switching to Normal TV Mode

1. Repeat steps 1 and 2 from the previous section.
2. OFF will flash in red in the lower corner of the screen, indicating Normal TV Mode.

*Refer to the illustrations of the front panel in the section entitled *Location of Controls*

IC101 IN/OUT Pins and Functions (VJC)

INPUT PINS  OUTPUT PINS 

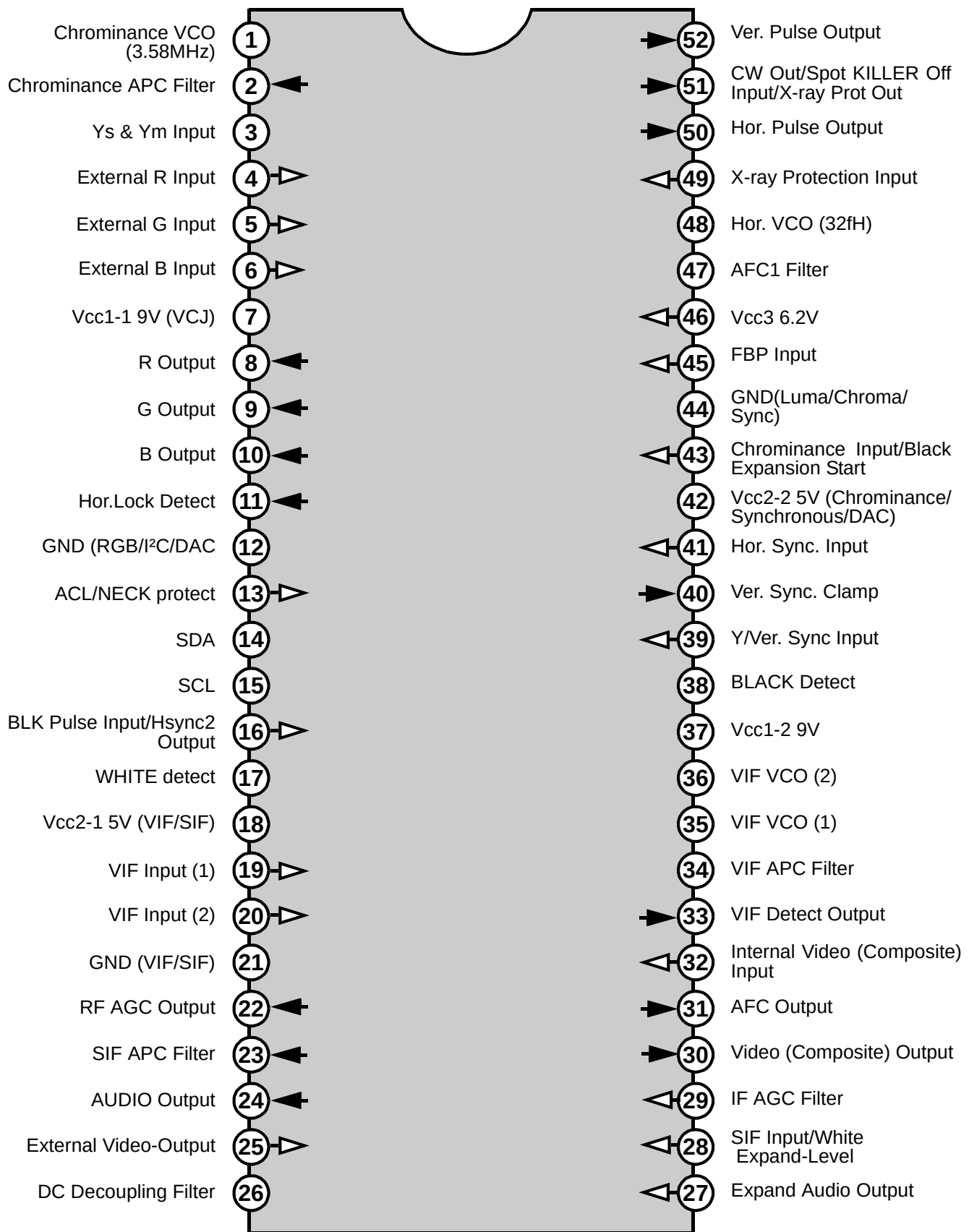


Figure 25. VCJ IN/OUT Pins and Functions.

IC001 IN/OUT Pins and Functions (MPU)

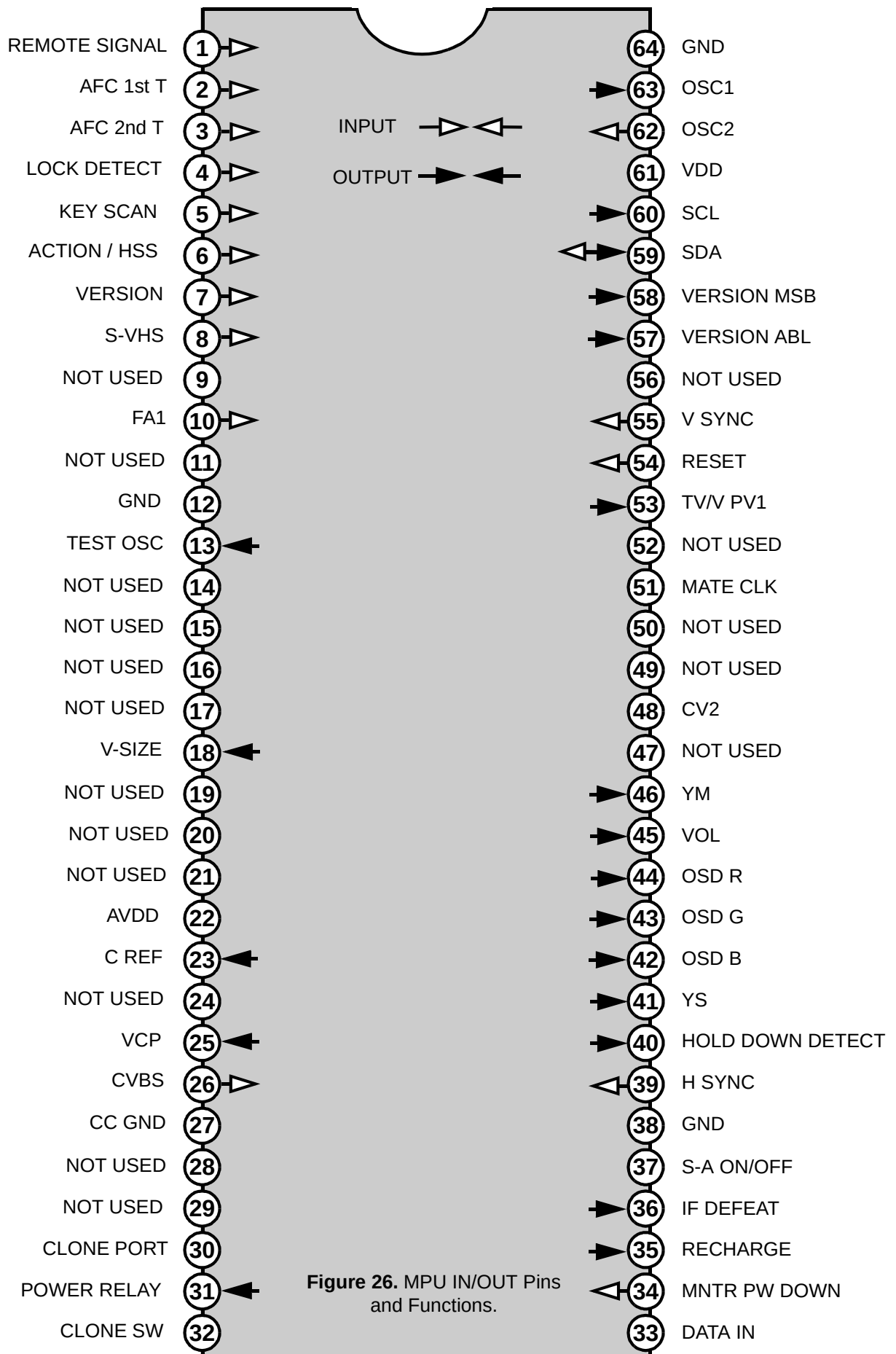


Figure 26. MPU IN/OUT Pins and Functions.

REPLACEMENT PARTS LIST

Models: CT-2511HDB, CT-2521HDB, CT-2721HDB, CT-3221HDB.

Important Safety Notice: Components printed in **BOLD TYPE** have special characteristics important for safety. When replacing any of these components use only manufacturer's specified parts.

REF NO.	PART NO.	DESCRIPTION
CAPRISTORS		
CRA801	EXNFGV	RES-CAP CT-3221HDB
CRA801	EXNG471P365	RES-CAP 470PF/3.6 MEG CT-2511HDB,CT-2521HDB CT-2721HDB
CRA802	EXNFGV	RES-CAP CT-3221HDB
CRA802	EXNG471P365	RES-CAP 470PF/3.6 ME CT-2511HDB,CT-2521HDB CT-2721HDB
CAPACITORS		
C001	ECA1AM101	CAP,E 100UF/10V
C003	ECA1HM4R7	CAP,E 4.7UF/50V
C004	ECJ2VC1H330J	CAP,C 33PF-J-50V
C005	ECJ2VC1H330J	CAP,C 33PF-J-50V
C008	ECJ2VF1H104Z	CAP,C .1UF-Z-50V
C010	ECJ2VF1H103Z	CAP,C .01UF-Z-50V
C011	ECA1CM221	CAP,E 220UF/16V
C013	ECA0JM101	CAP,E 100UF/6.3V
C016	ECJ2VC1H101J	CAP,C 100PF-J-50V
C017	ECJ2VC1H220J	CAP,C 22PF-J-50V
C018	ECJ2VC1H220J	CAP,C 22PF-J-50V
C019	ECA0JM101	CAP,E 100UF/6.3V
C020	ECA0JM101	CAP,E 100UF/6.3V
C022	ECA1CM471	CAP,E 470UF/16V
C024	ECA1EM4R7	CAP,E 4.7UF/25V
C025	ECJ2VC1H101J	CAP,C 100PF-J-50V
C026	ECA1HM010	CAP,E 1.0UF/50V
C031	ECJ2VB1H821K	CAP,C 820-J-50V
C032	ECA1AM470	CAP,E 47UF/10V
C033	ECJ2VC1H101J	CAP,C 100PF-J-50V
C035	ECJ2VC1H220J	CAP,C 22PF-J-50V
C036	ECJ2VC1H220J	CAP,C 22PF-J-50V
C037	ECJ2VC1H220J	CAP,C 22PF-J-50V
C038	ECJ2VC1H220J	CAP,C 22PF-J-50V
C101	ECJ2VF1H223Z	CAP,C .022UF-Z050V
C102	ECA1EM100	CAP,E 10UF/25V
C103	ECJ2VC1H300J	CAP,C 30PF-J-50V
C105	ECJ2VC1H221J	CAP,C 220PF-J-50V

REF NO.	PART NO.	DESCRIPTION
C106	ECA1HMR47	CAP,E .47UF/50V
C107	ECJ2VC1H470J	CAP,C 47PF-J-50V
C108	ECA1HMR22	CAP,E .22UF/50V
C109	EEANA1E4R7B	CAP,E 4.7UF-25V
C110	ECJ2VF1H103Z	CAP,C .01UF-Z-50V
C111	ECA1EM100	CAP,E 10UF/25V
C113	ECA1EM100	CAP,E 10UF/25V
C117	ECJ2VC1H070D	CAP,C 7PF-D-50V
C151	ECA1HMR22	CAP,E .22UF/50V
C201	ECJ2VF1H103Z	CAP,C .01UF-Z-50V
C202	ECJ2VC1H101J	CAP,C 100PF-J-50V
C203	ECA1EM4R7	CAP,E 4.7UF/25V
C301	ECJ2VC1H390J	CAP,C 39PF-J-50V
C302	EEANA1E1R0B	CAP,E 1.0UF-25V
C304	ECEA1HNR47U	CAP,E .47UF-50V
C305	ECA1EM4R7	CAP,E 4.7UF/25V
C306	ECA1CM221	CAP,E 220UF/16V
C308	ECQB1H823JM	CAP,P .082UF-J-50V
C309	ECA1AM101	CAP,E 100UF/10V
C310	ECA1EM4R7	CAP,E 4.7UF/25V
C311	ECA1EM4R7	CAP,E 4.7UF/25V
C312	ECA1EM220	CAP,E 22UF/25V
C314	ECJ2VF1H104Z	CAP,C .1UF-Z-50V
C351	ECJ2VB1H331K	CAP,C 330PF-K-50V CT-3221HDB
C351	ECJ2VB1H391K	CAP,C 390PF-K-50V CT-2511HDB ,CT-2521HDB CT-2721HDB
C352	ECJ2VB1H331K	CAP,C 330PF-K-50V CT-3221HDB
C352	ECJ2VB1H391K	CAP,C 390PF-K-50V CT-2511HDB ,CT-2521HDB CT-2721HDB
C353	ECJ2VB1H331K	CAP,C 330PF-K-50V CT-3221HDB
C353	ECJ2VB1H471K	CAP,C 470PF-K-50V CT-2511HDB,CT-2521HDB CT-2721HDB
C354	ECKD3D102KB	CAP,C .001UF-K-2KV
C357	EEANA1E1R0B	CAP,E 1.0UF-25V

REPLACEMENT PARTS LIST

Models: CT-2511HDB, CT-2521HDB, CT-2721HDB, CT-3221HDB.

Important Safety Notice: Components printed in **BOLD TYPE** have special characteristics important for safety. When replacing any of these components use only manufacturer's specified parts.

REF NO.	PART NO.	DESCRIPTION
C370	ECA1HM100	CAP,E 10UF/50V CT-2511HDB,CT-2521HDB
C401	ECQB1H153JM	CAP,P .015UF-J-50V
C402	ECJ2VB1H471K	CAP,C 470PF-K-50V
C403	ECA1HM2R2	CAP,E 2.2UF/50V
C451	ECA1AM470	CAP,E 47UF/10V
C452	ECSF1EE105	CAP,T 1.0UF/25V
C453	ECEA1HFS010	CAP,E 1UF/50V CT-2721HDB
C453	ECEA1HFS2R2	CAP,E 2.2UF/50V CT-3221HDB
C453	EEUFC1H1R0B	ECEA1HFS010B CT-2511HDB,CT-2521HDB
C454	ECA1EM102	CAP,E 1000UF/25V
C455	ECA1VHG101B	CAP,E 100UF-35V
C456	ECQB1H103JM	CAP,P .01UF-J-50V
C459	ECA1VM471	CAP,E 470UF/35V
C460	ECQM1104JZ	CAP,P .1UF-J-100V CT-2721HDB,CT-3221HDB
C462	ECA1EM100	CAP,E 10UF/25V
C501	ECJ2VC1H821J	CAP,C 820UF-J-50V CT-3221HDB
C502	ECQB1H223JM	CAP,P .022UF-J-50V
C503	ECA1HM2R2	CAP,E 2.2UF/50V
C504	ECJ2VC1H101J	CAP,C 100PF-J-50V
C505	ECJ2VU1H221J	CAP,C 220PF-J-50V
C506	ECA1CM221	CAP,E 220UF/16V
C507	ECJ2VC1H121J	CAP,C 120PF-J-50V CT-2511HDB,CT-2521HDB CT-2721HDB
C508	ECJ2VC1H121J	CAP,C 120PF-J-50V
C510	ECCD2H100D	CAP,C 10PF-D-500V
C511	ECKD2H821KB	CAP,C 820PF-K-500V
C512	ECKD2H101KB	CAP,C 100PF-K-500V
C531	ECA1EM220	CAP,E 22UF/25V
C532	ECA1AM102	CAP,E 1000UF/10V
C533	ECJ2VF1H103Z	CAP,C .01UF-Z-50V
C534	ECJ2VF1H103Z	CAP,C .01UF-Z-50V
C551	ECA1VM331	CAP,E 330UF/35V
C552	ECA1EM471	CAP,E 470UF/25V CT-2511HDB,CT-2521HDB CT-2721HDB

REF NO.	PART NO.	DESCRIPTION
C553	ECKD2H561KB	CAP,C 560PF-K-500V CT-2511HDB,CT-2521HDB CT-2721HDB
C554	ECKD2H561KB	CAP,C 560PF-K-500V
C555	ECEA2EU220	CAP,E 22UF/250V
C556	ECA1CM102	CAP,E 1000UF/16V CT-3221HDB
C556	ECA1CM471	CAP,E 470UF/16V CT-2511HDB,CT-2521HDB CT-2721HDB
C557	ECKD2H102KB	CAP,C .001UF-K-500V
C559	ECA1HM220	CAP,E 22UF/50V CT-2511HDB,CT-2521HDB CT-2721HDB
C560	EEANA1E2R2B	CAP,E 2.2UF-25V
C561	ECKD2H561KB	CAP,C 560PF-K-500V
C563	ECWH12H133JS	CAP,P .013UF-J-1.2KV CT-3221HDB
C563	ECWH12H822JS	CAP,P .0082UF-J-1.2KV CT-2511HDB,CT-2521HDB CT-2721HDB
C564	ECWH12H122JS	CAP,P .0012UF-J-1.2KV CT-3221HDB
C564	ECWH12H332JS	CAP,P .0033UF-J-1.2KV CT-2511HDB,CT-2521HDB CT-2721HDB
C565	ECKD3D102JB	CAP,C .001UF-J-2KV CT-3221HDB
C565	ECKD3D471JB	CAP,C 470PF-J-2KV CT-2511HDB CT-2521HDB
C565	ECKD3D561JB	CAP,C 560PF-J-2KV CT-3221HDB
C566	ECKD3D181JB	CAP,C 180PF-J-2KV
C567	ECQM4562JZ	CAP,P 5600PF-J-400V CT-3221HDB
C568	ECQM2274JZ	CAP,P .27UF-J-200V CT-2511HDB,CT-2521HDB CT-2721HDB
C568	ECQM4473JZ	CAP,P .047UF-J-400V CT-3221HDB
C569	ECWF2474JBB	CAP,P .47UF-J-200V CT-2721HDB,CT-3221HDB
C569	ECWF2564JBB	CAP,M .56UF-J-200V CT-2511HDB,CT-2521HDB
C570	ECA1AM102	CAP,E 1000UF/10V
C571	ECA1EM220	CAP,E 22UF/25V

REPLACEMENT PARTS LIST

Models: CT-2511HDB, CT-2521HDB, CT-2721HDB, CT-3221HDB.

Important Safety Notice: Components printed in **BOLD TYPE** have special characteristics important for safety. When replacing any of these components use only manufacturer's specified parts.

REF NO.	PART NO.	DESCRIPTION
C572	ECA1EM100	CAP,E 10UF/25V
C573	ECA1CM101	CAP,E 100UF/16V
C601	ECJ2VC1H181J	CAP,C 180PF-J-50V
C602	ECJ2VC1H680J	CAP,C 68PF-J-50V
C604	ECJ2VU1H150J	CAP,C 15PF-J-50V
C605	ECJ2VB1H332K	CAP,C .0033UF-K-50V
C606	ECA1HM010	CAP,E 1.0UF/50V
C754	ECQB1H104JF	CAP,P .1UF-J-50V CT-3221HDB
C755	ECQB1H104JF	CAP,P .1UF-J-50V CT-3221HDB
C756	ECA1CM221	CAP,E 220UF/16V CT-3221HDB
C757	ECA1VM221	CAP,E 220UF/35V CT-3221HDB
C759	ECQE1395KN	CAP,P 3.9UF-K-100V CT-3221HDB
C760	TACCV101T50V	CAP,C 100PF/50V CT-3221HDB
C801	ECKDAE472ZED	CAP,C .4700PF-Z-250VAC
C802	ECKDAE472ZED	CAP,C .4700PF-Z-250VAC
C805	EC0S2DA221BB	CAP,E 220UF/200V CT-2511HDB,CT-2521HDB CT-2721HDB
C805	EC0S2DA331BB	CAP,E 330UF/200V CT-3221HDB
C806	EC0S2DA221BB	CAP,E 220UF/200V CT-2511HDB,CT-2521HDB CT-2721HDB
C806	EC0S2DA331BB	CAP,E 330UF/200V CT-3221HDB
C807	ECA1HM2R2	CAP,E 2.2UF/50V CT-3221HDB
C807	ECA1HM3R3	CAP,E 3.3UF/50V CT-2511HDB,CT-2521HDB CT-2721HDB
C808	ECA1CM101	CAP,E 100UF/16V
C809	EC0S2DG151DG	CAP,E 151UF/200V
C810	ECQU2A153MV	CAP,P .015UF-M-250V
C811	ECQU2A153MV	CAP,P .015UF-M-250V
C812	ECQU2A224MV	CAP,P .22UF-M-250VAC
C814	ECQB1H333JM	CAP,P .033UF-J-50V CT-2511HDB,CT-2521HDB CT-2721HDB
C814	ECQB1H823JM	CAP,P .082UF-J-50V CT-3221HDB
C815	ECA1EHG101B	CAP,E 100UF-25V
C818	ECKD3A821KB	CAP,C 820PF-K-1KVDC

REF NO.	PART NO.	DESCRIPTION
C820	ECA1JHG100B	CAP,E 10UF-63V
C821	ECKD2H561KB	CAP,C 560PF-K-500V CT-3221HDB
C822	ECA1EM221	CAP,E 220UF/25V CT-3221HDB
C823	ECEA160V33Z	CAP,E 33UF/160V
C824	ECKD3A331KB	CAP,C 330PF-K-1KV
C825	ECKD3A471KB	CAP,C 470PF-K-1KV
C1001	ECA1CM471	CAP,E 470UF/16V CT-2521HDB,CT-2721HDB CT-3221HDB
C1002	TACCX103T50V	CAP,C .01UF/50V CT-2521HDB,CT-2721HDB CT-3221HDB
C1003	ECA0JM101	CAP,E 100UF/6.3V CT-2521HDB,CT-2721HDB CT-3221HDB
C1004	TACCX103T50V	CAP,C .01UF/50V CT-2521HDB,CT-2721HDB CT-3221HDB
C1005	TACCX103T50V	CAP,C .01UF/50V CT-2521HDB,CT-2721HDB CT-3221HDB
C2301	ECA1EM471	CAP,E 470UF/25V
C2302	ECA1HHG3R3B	CAP,E 3.3UF-50V
C2303	ECA1EHG100B	CAP,E 10UF-25V
C2304	ECQB1H104JM	CAP,P .1UF-J-50V
C2306	ECA1CM471	CAP,E 470UF/16V
C2307	EEANA1E1R0B	CAP,E 1.0UF-25V
C2309	ECA1HHG010B	CAP,E 1UF-50V
C2310	ECJ2VB1H222K	CAP,C .0022UF-K-50V
C2311	ECA1HM3R3	CAP,E 3.3UF/50V
C2351	ECA1EM102	CAP,E 1000UF/25V
C2352	ECA1HHG3R3B	CAP,E 3.3UF-50V
C2353	ECA1EHG100B	CAP,E 10UF-25V
C2354	ECQB1H104JM	CAP,P .1UF-J-50V
C2356	ECA1CM471	CAP,E 470UF/16V
C2357	EEANA1E1R0B	CAP,E 1.0UF-25V
C2358	ECJ2VB1H222K	CAP,C .0022UF-K-50V
C2451	ECA1EM100	CAP,E 10UF/25V
C2452	ECA1EM100	CAP,E 10UF/25V
C2453	ECA1EM4R7	CAP,E 4.7UF/25V

REPLACEMENT PARTS LIST

Models: CT-2511HDB, CT-2521HDB, CT-2721HDB, CT-3221HDB.

Important Safety Notice: Components printed in **BOLD TYPE** have special characteristics important for safety. When replacing any of these components use only manufacturer's specified parts.

REF NO.	PART NO.	DESCRIPTION
C2454	ECA1CM221	CAP,E 220UF/16V
C3001	ECA1HM010	CAP,E 1.0UF/50V
C3002	ECA1HM010	CAP,E 1.0UF/50V CT-2521HDB,CT-2721HDB CT-3221HDB
C3003	ECA1HM010	CAP,E 1.0UF/50V
C3005	ECJ2VB1H122K	CAP,C .0012UF-K-50V
JS2302	ECEA1HN010U	CAP,E 1UF/50V
DIODES		
D001	ERA15-01	DIODE
D002	MA165	DIODE
D003	MA4047H	DIODE
D006	MA4330H	DIODE
D008	MA165	DIODE
D009	MA165	DIODE
D011	MA165	DIODE
D014	MA165	DIODE
D015	MA165	DIODE
D016	MA165	DIODE
D017	MA165	DIODE
D052	MA4068M	DIODE, ZENER
D451	ERA15-01	DIODE
D452	MA4047M	DIODE, ZENER
D453	MA165	DIODE
D501	MA4082L	DIODE
D531	AS01	DIODE
D532	MA4062L	DIODE
D551	TVSRU2N	DIODE
D553	AU02	DIODE CT-2511HDB CT-2521HDB,CT-2721HDB
D554	AU02	DIODE
D555	MA165	DIODE
D556	MA4360H	DIODE, ZENER
D558	RS3FS	DIODE
D559	BYD33G-113	DIODE
D560	MA165	DIODE
D561	AU02	DIODE

REF NO.	PART NO.	DESCRIPTION
D751	MA2270B	DIODE CT-3221HDB
D801	GP15KL-042	DIODE
D802	GP15KL-042	DIODE
D805	TAP111M003	DIODE CT-2721HDB,CT-3221HDB
D805	TRPW5B0M050D	THERMISTOR CT-2511HDB CT-2521HDB
D806	MA4047H	DIODE
D807	MA165	DIODE
D809	RU3YX-M	DIODE CT-3221HDB
D820	EU02V1	DIODE
D821	EU02V1	DIODE
D822	EU02V1	DIODE
D823	RL30A	DIODE
D824	EU02V1	DIODE
D825	TVSSR2KL	DIODE, PROTECTION
D826	EU02V1	DIODE
D829	MA165	DIODE
D830	MA4270M	DIODE CT-3221HDB
D1001	MA4068M	DIODE, ZENER CT-2521HDB,CT-2721HDB CT-3221HDB
D1002	MA4068M	DIODE, ZENER CT-2521HDB,CT-2721HDB CT-3221HDB
D1003	MA4068M	DIODE, ZENER CT-2521HDB,CT-2721HDB CT-3221HDB
D2301	MA165	DIODE
D2302	MA165	DIODE
D2312	MA4068M	DIODE, ZENER
D3002	MA4110M	DIODE, ZENER
D3004	MA4110M	DIODE, ZENER
D3006	MA4110M	DIODE, ZENER CT-2521HDB,CT-2721HDB CT-3221HDB
D3007	MA4110M	DIODE, ZENER CT-2521HDB,CT-2721HDB CT-3221HDB
D3008	MA4110M	DIODE, ZENER CT-2521HDB,CT-2721HDB CT-3221HDB

REPLACEMENT PARTS LIST

Models: CT-2511HDB, CT-2521HDB, CT-2721HDB, CT-3221HDB.

Important Safety Notice: Components printed in **BOLD TYPE** have special characteristics important for safety. When replacing any of these components use only manufacturer's specified parts.

REF NO.	PART NO.	DESCRIPTION
D3009	MA4110M	DIODE, ZENER CT-2521HDB, CT-2721HDB CT-3221HDB
D3016	MA3056M	DIODE
FUSES		
F801	XBA2A00101	FUSE 6.3A 125V
INTEGRATED CIRCUITS		
IC001	MN1874088TD0	INT CKT
IC002	M24C16-WBN6	INT CKT
IC003	RPM6937-V12	INT CKT
IC101	AN5165K	INT CKT
IC451	LA7838	INT CKT
IC551	AN78M09	PLUS 9V AVR
IC552	AN78M05	PLUS 5V AVR
IC801	PC817X2	INT CKT
IC803	STR58041A	INT CKT
IC1001	TC4066BP	INT CKT CT-2521HDB CT-2721HDB, CT-3221HDB
IC2303	LA4285	INT CKT
IC2304	LA4285	INT CKT
IC2451	AN5285K	INT CKT
COILS		
L001	TLTABT2R2K	COIL, PEAKING 2.2UH
L002	ELESN390KA	COIL, PEAKING 39UH
L003	TLTABT2R2K	COIL, PEAKING 2.2UH
L004	TLTABT2R2K	COIL, PEAKING 2.2UH
L006	EXCELSA24T	FERRITE BEAD
L008	TLTABT470K	COIL, PEAKING 47UH
L009	EXCELSA35	FERRITE BEAD
L012	EXCELSA24T	FERRITE BEAD
L103	TLTABT120K	COIL, PEAKING 12UH
L104	TLTABT1R0K	COIL, PEAKING 1.0UH
L105	EIV7EN053B	COIL, VCO
L106	ELESN180JA	COIL, PEAKING 18UH
L241	EXCELSA24T	FERRITE BEAD
L253	EXCELSA35	FERRITE BEAD
L351	TLTABT101K	COIL, PEAKING

REF NO.	PART NO.	DESCRIPTION
L551	ELH5L7103	COIL CT-2721HDB
L551	ELH5L7115	COIL CT-3221HDB
L551	TLH6663P	COIL, LINEARITY CT-2511HDB, CT-2521HDB
L602	ELESN120JA	COIL, PEAKING 12UH
L751	ELC18B301L	COIL, CHOKE CT-3221HDB
L752	EXCELD35	FERRITE BEAD CT-3221HDB
L801	ELF17N017A	LINE FILTER CT-2511HDB CT-2521HDB, CT-2721HDB
L801	ELF20N020A	COIL, 2UH CT-3221HDB
L802	ELEIE680KA	COIL, PEAKING 68UH CT-2511HDB, CT-2521HDB CT-2721HDB
L803	ELF17N007A	LINE FILTER CT-3221HDB
L804	EXCELSA39	FERRITE BEAD
L2302	TLTABT2R2K	COIL, PEAKING 2.2UH
TRANSISTORS		
Q001	2SD601ARTX	TRANSISTOR
Q002	2SC1685QRS	TRANSISTOR
Q003	2SB709ARTX	TRANSISTOR
Q004	2SB709ARTX	TRANSISTOR
Q302	2SD601ARTX	TRANSISTOR
Q304	2SD601ARTX	TRANSISTOR
Q351	2SC3063	TRANSISTOR
Q352	2SC3063	TRANSISTOR
Q353	2SC3063	TRANSISTOR
Q430	2SD601ARTX	TRANSISTOR
Q451	2SD601ARTX	TRANSISTOR
Q452	2SD601ARTX	TRANSISTOR
Q501	2SC4212H	TRANSISTOR
Q551	2SD2539MA1	TRANSISTOR
Q751	2SC1685QRS	TRANSISTOR CT-3221HDB
Q752	2SA564AQRSTA	TRANSISTOR CT-3221HDB
Q753	2SD1266P	TRANSISTOR CT-3221HDB
Q801	2SC1685RSTA	TRANSISTOR
Q802	2SC1384RS	TRANSISTOR
Q804	2SA1767Q	TRANSISTOR

REPLACEMENT PARTS LIST

Models: CT-2511HDB, CT-2521HDB, CT-2721HDB, CT-3221HDB.

Important Safety Notice: Components printed in **BOLD TYPE** have special characteristics important for safety. When replacing any of these components use only manufacturer's specified parts.

REF NO.	PART NO.	DESCRIPTION
Q1001	2SC1685QRS	TRANSISTOR CT-2521HDB CT-2721HDB,CT-3221HDB
Q1002	2SC1685QRS	TRANSISTOR CT-2521HDB CT-2721HDB,CT-3221HDB
Q1003	2SC1685QRS	TRANSISTOR CT-2521HDB CT-2721HDB CT-3221HDB
Q1004	2SC1685QRS	TRANSISTOR CT-2521HDB CT-2721HDB CT-3221HDB
Q1005	2SC1685QRS	TRANSISTOR CT-2521HDB CT-2721HDB CT-3221HDB
Q1006	2SC1685QRS	TRANSISTOR CT-2521HDB CT-2721HDB CT-3221HDB
Q1007	2SC1685QRS	TRANSISTOR CT-2521HDB CT-2721HDB CT-3221HDB
Q2309	2SB709ARTX	TRANSISTOR
RELAYS		
RL801	TSEH8007	RELAY
RESISTORS		
R002	ERJ6GEYJ182	RES,M 1.8K-J-1/10
R003	ERJ6GEYJ562	RES,M 5.6K-J-1/10
R004	ERDS1TJ181	RES,C 180-J-1/2
R005	ERDS2TJ101	RES,C 100-J-1/4
R006	ERJ6GEYJ102	RES,M 1K-J-1/10
R007	ERJ6GEYJ102	RES,M 1K-J-1/10
R008	ERJ6GEYJ562	RES,M 5.6K-J-1/10
R010	ERJ6GEYJ154	RES,M 150K-J-1/10
R011	ERJ6GEYJ684	RES,M 680K-J-1/10
R012	ERJ6GEYJ473	RES,M 47K-J-1/10
R014	ERJ6GEYJ472	RES,M 4.7K-J-1/10
R015	ERJ6GEYJ472	RES,M 4.7K-J-1/10
R016	ERJ6GEYJ472	RES,M 4.7K-J-1/10
R017	ERJ6GEYJ472	RES,M 4.7K-J-1/10
R020	ERJ6GEYJ474	RES,M 470K-J-1/10
R021	ERJ6GEYJ101	RES,M 100-J-1/10
R022	ERJ6GEYJ101	RES,M 100-J-1/10
R023	ERJ6GEYJ102	RES,M 1K-J-1/10
R025	ERJ6GEYJ223	RES,M 22K-J-1/10
R026	ERJ6GEYJ273	RES,M 27K-J-1/10
R027	ERJ6GEYJ622	RES,M 6.2K-J-1/10

REF NO.	PART NO.	DESCRIPTION
R028	ERJ6GEYJ103	RES,M 10K-J-1/10
R030	ERJ6GEYJ102	RES,M 1K-J-1/10
R032	ER0S2CKF1002	RES,M 10K-F-1/4
R033	ERJ6GEYJ222	RES,M 2.2K-J-1/10
R034	ERJ6GEYJ222	RES,M 2.2K-J-1/10
R035	ERJ6GEYJ332	RES,M 3.3K-J-1/10
R036	ERJ6GEYJ562	RES,M 5.6K-J-1/10
R037	ERJ6GEYJ103	RES,M 10K-J-1/10
R038	ERJ6GEYJ223	RES,M 22K-J-1/10
R039	ERDS2TJ102	RES,C 1K-J-1/4
R046	ERDS2TJ102	RES,C 1K-J-1/4
R048	ERJ6GEYJ221	RES,M 220-J-1/10
R049	ERJ6GEYJ221	RES,M 220-J-1/10
R053	ERJ6GEYJ103	RES,M 10K-J-1/10
R055	ERJ6GEYJ103	RES,M 10K-J-1/10
R060	ERJ6GEYJ102	RES,M 1K-J-1/10
R065	ERJ6GEYJ471	RES,M 470-J-1/10
R066	ERJ6GEYJ222	RES,M 2.2K-J-1/10
R067	ERJ6GEYJ222	RES,M 2.2K-J-1/10
R068	ERJ6GEYJ222	RES,M 2.2K-J-1/10
R070	ERJ6GEYJ101	RES,M 100-J-1/10
R101	ERJ6GEYJ750	RES,M 75-J-1/10
R102	ERJ6GEYJ683	RES,M 68K-J-1/10
R103	ERJ6GEYJ183	RES,M 18K-J-1/10
R104	ERJ6GEYJ681	RES,M 680-J-1/10
R105	ERJ6GEYJ681	RES,M 680-J-1/10
R107	ERJ6GEYJ222	RES,M 2.2K-J-1/10
R108	ERJ6GEYJ471	RES,M 470-J-1/10
R152	ERDS2TJ183	RES,C 18K-J-1/4
R153	ERJ6GEYJ223	RES,M 22K-J-1/10
R154	ERJ6GEYJ393	RES,M 39K-J-1/10
R201	ERJ6GEYJ471	RES,M 470-J-1/10
R202	ERJ6GEYJ101	RES,M 100-J-1/10
R303	ERJ6GEYJ682	RES,M 6.8K-J-1/10
R304	ERJ6GEYJ332	RES,M 3.3K-J-1/10
R305	ER0S2CKF3001	RES,M 3K-F-1/4

REPLACEMENT PARTS LIST

Models: CT-2511HDB, CT-2521HDB, CT-2721HDB, CT-3221HDB.

Important Safety Notice: Components printed in **BOLD TYPE** have special characteristics important for safety. When replacing any of these components use only manufacturer's specified parts.

REF NO.	PART NO.	DESCRIPTION
R306	ERJ6ENF1801	RES,M 1.8K-F-1/10W
R307	ERJ6GEYJ564	RES,M 560K-J-1/10
R308	ERJ6GEYJ102	RES,M 1K-J-1/10
R309	ERJ6GEYJ683	RES,M 68K-J-1/10
R310	ERJ6GEYJ273	RES,M 27K-J-1/10
R311	ERJ6GEYJ185	RES,M 1.8MEG-J-1/10W
R317	ERJ6GEYJ684	RES,M 680K-J-1/10
R319	ERJ6GEYJ122	RES,M 1.2K-J-1/10
R320	ERJ6GEYJ102	RES,M 1K-J-1/10
R351	ERG2FJ123H	RES,M 12K-J-2W
R352	ERG2FJ123H	RES,M 12K-J-2W
R353	ERG2FJ123H	RES,M 12K-J-2W
R354	ERDS1TJ272	RES,C 2.7K-J-1/2
R355	ERDS1TJ272	RES,C 2.7K-J-1/2
R356	ERDS1TJ272	RES,C 2.7K-J-1/2
R357	ERJ6GEYJ271	RES,M 270-J-1/10 CT-3221HDB
R357	ERJ6GEYJ301	RES,M 300-J-1/10 CT-2511HDB CT-2521HDB,CT-2721HDB
R358	ERJ6GEYJ271	RES,M 270-J-1/10 CT-3221HDB
R358	ERJ6GEYJ301	RES,M 300-J-1/10 CT-2511HDB CT-2521HDB CT-2721HDB
R359	ERJ6GEYJ271	RES,M 270-J-1/10 CT-3221HDB
R359	ERJ6GEYJ301	RES,M 300-J-1/10 CT-2511HDB CT-2521HDB CT-2721HDB
R360	ERJ6GEYJ102	RES,M 1K-J-1/10 CT-2511HDB CT-2521HDB CT-2721HDB
R360	ERJ6GEYJ911	RES,M 910-J-1/10 CT-3221HDB
R361	ERJ6GEYJ102	RES,M 1K-J-1/10 CT-2511HDB CT-2521HDB CT-2721HDB
R361	ERJ6GEYJ911	RES,M 910-J-1/10 CT-3221HDB
R362	ERJ6GEYJ102	RES,M 1K-J-1/10 CT-2511HDB CT-2521HDB CT-2721HDB
R362	ERJ6GEYJ911	RES,M 910-J-1/10 CT-3221HDB
R363	ERJ6GEYJ101	RES,M 100-J-1/10
R364	ERJ6GEYJ101	RES,M 100-J-1/10
R365	ERJ6GEYJ101	RES,M 100-J-1/10
R370	ERDS2TJ224	RES,C 220K-J-1/4 CT-2511HDB CT-2521HDB

REF NO.	PART NO.	DESCRIPTION
R371	ERDS2TJ393	RES,C 39K-J-1/4 CT-2511HDB CT-2521HDB
R401	ERJ6GEYJ102	RES,M 1K-J-1/10
R430	ERJ6GEYJ103	RES,M 10K-J-1/10
R432	ERJ6GEYJ102	RES,M 1K-J-1/10
R451	ERDS1FJ1R0	RES,C 1.0-J-1/2 CT-2511HDB CT-2521HDB CT-2721HDB
R451	ERDS1FJ1R2	RES,C 1.2-J-1/2 CT-3221HDB
R453	ERJ6GEYJ224	RES,M 220K-J-1/10 CT-2511HDB CT-2521HDB
R454	ERJ6GEYJ393	RES,M 39K-J-1/10 CT-3221HDB
R454	ERJ6GEYJ473	RES,M 47K-J-1/10 CT-2511HDB CT-2521HDB CT-2721HDB
R455	ERJ6GEYJ183	RES,M 18K-J-1/10
R456	ERJ6GEYJ223	RES,M 22K-J-1/10 CT-2721HDB CT-3221HDB
R456	ERJ6GEYJ243	RES,M 24K-J-1/10 CT-2511HDB CT-2521HDB
R457	ERJ6GEYJ122	RES,M 1.2K-J-1/10 CT-2511HDB CT-2521HDB
R457	ERJ6GEYJ152	RES,M 1.5K-J-1/10 CT-2721HDB
R457	ERJ6GEYJ392	RES,M 3.9K-J-1/10 CT-3221HDB
R458	ERJ6GEYJ273	RES,M 27K-J-1/10 CT-2511HDB CT-2521HDB
R458	ERJ6GEYJ333	RES,M 33K-J-1/10 CT-2721HDB CT-3221HDB
R459	ERJ6GEYJ683	RES,M 68K-J-1/10
R460	ERDS1TJ331	RES,C 330-J-1/2 CT-2511HDB CT-2521HDB
R460	ERDS2TJ102	RES,C 1K-J-1/4 CT-2721HDB CT-3221HDB
R462	ERJ6GEYJ473	RES,M 47K-J-1/10
R463	ERJ6GEYJ473	RES,M 47K-J-1/10
R464	ERDS1FJ1R5	RES,C 1.5-J-1/2 CT-2721HDB CT-3221HDB
R465	ERJ6GEYJ103	RES,M 10K-J-1/10
R466	ERJ6GEYJ103	RES,M 10K-J-1/10
R467	ERJ6GEYJ104	RES,M 100K-J-1/10
R468	ERJ6GEYJ101	RES,M 100-J-1/10
R469	ERJ6GEYJ220	RES,M 22-J-1/10
R471	ERJ6GEYJ223	RES,M 22K-J-1/10

REPLACEMENT PARTS LIST

Models: CT-2511HDB, CT-2521HDB, CT-2721HDB, CT-3221HDB.

Important Safety Notice: Components printed in **BOLD TYPE** have special characteristics important for safety. When replacing any of these components use only manufacturer's specified parts.

REF NO.	PART NO.	DESCRIPTION
R501	ERJ6GEYJ102	RES,M 1K-J-1/10
R502	ERDS2TJ562	RES,C 5.6K-J-1/4
R503	ERJ6GEYJ822	RES,M 8.2K-J-1/10
R504	ERJ6GEYJ561	RES,M 560-J-1/10
R505	ERJ6GEYJ682	RES,M 6.8K-J-1/10
R506	ERJ6GEYJ182	RES,M 1.8K-J-1/10
R507	ERJ6GEYJ392	RES,M 3.9K-J-1/10
R508	ERJ6GEYJ562	RES,M 5.6K-J-1/10
R509	ERDS2TJ331	RES,C 330-J-1/4
R510	ERG3FJ362H	RES,M 3.6K-J-3W CT-2721HDB CT-3221HDB
R510	ERG3FJ392H	RES,M 3.9K-J-3W CT-2511HDB CT-2521HDB
R511	ERG3FJ362H	RES,M 3.6K-J-3W CT-2721HDB CT-3221HDB
R511	ERG3FJ392H	RES,M 3.9K-J-3W CT-2511HDB CT-2521HDB
R512	ERG2FJ392H	RES,M 3.9K-J-2W CT-2721HDB CT-3221HDB
R512	ERG2FJ562H	RES,M 5.6K-J-2W CT-2511HDB CT-2521HDB
R531	ERD25FJ470	RES,C 47-J-1/4
R532	ERJ6ENF5362	RES,M 53.6K-F-1/10W CT-3221HDB
R532	ERJ6ENF5602	RES,M 56K-F-1/10 CT-2511HDB CT-2521HDB CT-2721HDB
R533	ERJ6ENF1692	RES,M 16.9K-F-1/10 CT- 3221HDB
R533	ERJ6ENF2102	RES,M 21K-F-1/10 CT-2721HDB
R533	ERJ6ENF2152	RES,M 21.5K-F-1/10W CT-2511HDB CT-2521HDB
R536	ERJ6GEYJ223	RES,M 22K-J-1/10
R537	ERJ6GEYJ473	RES,M 47K-J-1/10
R551	ERDS1FJ1R0	RES,C 1.0-J-1/2
R552	ERDS1FJ1R0	RES,C 1.0-J-1/2
R553	ERDS1FJ1R0	RES,C 1.0-J-1/2 CT-2511HDB CT-2521HDB CT-2721HDB
R554	ERG2FJ390H	RES,M 39-J-2W
R556	ERDS2TJ272	RES,C 2.7K-J-1/4
R557	ERDS2TJ103	RES,C 10K-J-1/4
R558	ERQ1CKPR56	RES,F .56-K-1W CT-2721HDB

REF NO.	PART NO.	DESCRIPTION
R558	ERQ1CZKR33	RES,F .33-K-1W CT-2511HDB CT-2521HDB
R558	ERQ2CJP1R8	RES,F 1.8-J-2W CT-3221HDB
R559	ERG2FJ683H	RES,M 12K-J-2W
R560	ERG2FJ122H	RES,M 12K-J-2W CT-2721HDB
R560	ERG2FJ182H	RES,M 1.8K-J-2W CT-2511HDB CT-2521HDB
R561	ERG2FJ102H	RES,M 1K-J-2W
R563	ERDS2TJ393	RES,C 39K-J-1/4 CT-2511HDB CT-2521HDB CT-2721HDB
R563	ERDS2TJ683	RES,C 68K-J-1/4 CT-3221HDB
R564	ERDS2TJ104	RES,C 100K-J-1/4 CT-2511HDB CT-2521HDB CT-2721HDB
R564	ERDS2TJ563	RES,C 56K-J-1/4 CT-3221HDB
R565	ERDS2TJ103	RES,C 10K-J-1/4
R567	ERG2FJ471H	RES,M 470-J-2W CT-2511HDB CT-2521HDB
R602	ERJ6GEYJ331	RES,M 330-J-1/10
R603	ERJ6GEYJ331	RES,M 330-J-1/10
R604	ERJ6GEYJ331	RES,M 330-J-1/10
R611	ERJ6GEYJ333	RES,M 33K-J-1/10
R612	ERJ6GEYJ333	RES,M 33K-J-1/10
R613	ERJ6GEYJ333	RES,M 33K-J-1/10
R614	ERJ6GEYJ332	RES,M 3.3K-J-1/10
R752	ERDS2TJ333	RES,C 33K-J-1/4 CT-3221HDB
R753	ERDS2TJ103	RES,C 10K-J-1/4 CT-3221HDB
R754	ERG3FJ562	RES,M 5.6K-J-3W CT-3221HDB
R755	ERDS2TJ563	RES,C 56K-J-1/4 CT-3221HDB
R756	ERDS2TJ103	RES,C 10K-J-1/4 CT-3221HDB
R757	ERDS2TJ224	RES,C 220K-J-1/4 CT-3221HDB
R758	ERDS2TJ273	RES,C 27K-J-1/4 CT-3221HDB
R759	ERDS2TJ222	RES,C 2.2K-J-1/4 CT-3221HDB
R760	EVND8AA03B53	CONTROL 5K CT-3221HDB
R761	EVND8AA03B14	CONTROL 10K CT-3221HDB
R762	ERDS2TJ182	RES,C 1.8K-J-1/4 CT-3221HDB
R763	ERDS2TJ183	RES,C 18K-J-1/4 CT-3221HDB
R764	ERDS2TJ154	RES,C 150K-J-1/4 CT-3221HDB
R765	ERDS2TJ272	RES,C 2.7K-J-1/4 CT-3221HDB

REPLACEMENT PARTS LIST

Models: CT-2511HDB, CT-2521HDB, CT-2721HDB, CT-3221HDB.

Important Safety Notice: Components printed in **BOLD TYPE** have special characteristics important for safety. When replacing any of these components use only manufacturer's specified parts.

REF NO.	PART NO.	DESCRIPTION	REF NO.	PART NO.	DESCRIPTION
R766	ERDS2TJ362	RES,C 3.6K-J-1/4 CT-3221HDB	R1010	ERJ6GEYJ103	RES,M 10K-J-1/10
R767	ERDS2TJ222	RES,C 2.2K-J-1/4 CT-3221HDB	R1011	ERDS2TJ103	RES,C 10K-J-1/4 CT-2521HDB CT-2721HDB CT-3221HDB
R768	ERQ2CJP100	RES,F 10-J-2W CT-3221HDB	R1012	ERDS2TJ104	RES,C 100K-J-1/4 CT-2521HDB CT-2721HDB CT-3221HDB
R801	ERF7ZK1R5	RES,W 1.5-K-7W	R1013	ERDS2TJ103	RES,C 10K-J-1/4 CT-2521HDB CT-2721HDB CT-3221HDB
R805	ERDS2TJ274	RES,C 270K-J-1/4	R1015	ERDS2TJ105	RES,C 1MEG-J-1/4 CT-2521HDB CT-2721HDB CT-3221HDB
R806	ERDS2TJ274	RES,C 270K-J-1/4	R1017	ERDS2TJ681	RES,C 680-J-1/4 CT-2521HDB CT-2721HDB CT-3221HDB
R808	ERDS1FJ1R0	RES,C 1.0-J-1/2	R1018	ERDS2TJ101	RES,C 100-J-1/4 CT-2521HDB CT-2721HDB CT-3221HDB
R809	ERDS1FJ1R0	RES,C 1.0-J-1/2	R1019	ERDS2TJ101	RES,C 100-J-1/4 CT-2521HDB CT-2721HDB CT-3221HDB
R810	ERDS1FJ272	RES,C 2.7K-J-1/2	R1020	ERDS2TJ561	RES,C 560-J-1/4 CT-2521HDB CT-2721HDB CT-3221HDB
R812	ERDS1TJ183	RES,C 18K-J-1/2	R1021	ERDS2TJ103	RES,C 10K-J-1/4 CT-2521HDB CT-2721HDB CT-3221HDB
R813	ERJ6GEYJ562	RES,M 5.6K-J-1/10	R1022	ERDS2TJ101	RES,C 100-J-1/4 CT-2521HDB CT-2721HDB CT-3221HDB
R815	ERC12ZGM825	RES,S 8.2MEG-M-1/2	R1023	ERDS2TJ101	RES,C 100-J-1/4 CT-2521HDB CT-2721HDB CT-3221HDB
R819	ERQ1CJR56	RES,F .56-J-1W CT-3221HDB	R1028	ERDS2TJ103	RES,C 10K-J-1/4 CT-2521HDB CT-2721HDB CT-3221HDB
R820	ERJ6GEYJ153	RES,M 15K-J-1/10	R1029	ERDS2TJ103	RES,C 10K-J-1/4 CT-2521HDB CT-2721HDB CT-3221HDB
R821	ERJ6GEYJ392	RES,M 3.9K-J-1/10	R1030	ERDS2TJ103	RES,C 10K-J-1/4 CT-2521HDB CT-2721HDB CT-3221HDB
R822	ERD50FJ474	RES,C 470K-J-1/2W	R1031	ERDS2TJ103	RES,C 10K-J-1/4 CT-2521HDB CT-2721HDB CT-3221HDB
R823	ERDS2TJ222	RES,C 2.2K-J-1/4	R1032	ERDS2TJ103	RES,C 10K-J-1/4 CT-2521HDB CT-2721HDB CT-3221HDB
R824	ERG3FJ390	RES,M 39-J-3W	R1033	ERDS2TJ104	RES,C 100K-J-1/4 CT-2521HDB CT-2721HDB CT-3221HDB
R825	ERDS2TJ102	RES,C 1K-J-1/4	R1034	ERDS2TJ103	RES,C 10K-J-1/4 CT-2521HDB CT-2721HDB CT-3221HDB
R826	ERF2AKR18	RES,W .18-K-2W CT-3221HDB	R1035	ERDS2TJ103	RES,C 10K-J-1/4 CT-2521HDB CT-2721HDB CT-3221HDB
R826	ERF2AKR22	RES,W .22-K-2W CT-2511HDB CT-2521HDB CT-2721HDB	R1036	ERDS2TJ102	RES,C 1K-J-1/4 CT-2521HDB CT-2721HDB CT-3221HDB
R827	ERDS1FJ561	RES,C 560-J-1/2	R1037	ERDS2TJ105	RES,C 1MEG-J-1/4 CT-2521HDB CT-2721HDB CT-3221HDB
R828	ERG3FJ470H	RES,M 47-J-3W	R2301	ERQ2CJP120	RES,F 12-J-2W
R829	ERQ14AJ180	RES,F 180-J-1/4 CT-2511HDB CT-2521HDB CT-2721HDB	R2303	ERD25FJ1R0	RES,C 1.0-J-1/4
R829	ERQ14AJ6R8	RES,F 6.8-J-1/4 CT-3221HDB			
R1001	ERJ6GEYJ102	RES,M 1K-J-1/10			
R1002	ERJ6GEYJ101	RES,M 100-J-1/10			
R1003	ERJ6GEYJ101	RES,M 100-J-1/10			
R1004	ERJ6GEYJ221	RES,M 220-J-1/10			
R1005	ERJ6GEYJ102	RES,M 1K-J-1/10			
R1006	ERJ6GEYJ102	RES,M 1K-J-1/10			
R1007	ERJ6GEYJ102	RES,M 1K-J-1/10			
R1008	ERJ6GEYJ102	RES,M 1K-J-1/10			
R1010	ERDS2TJ472	RES,C 4.7K-J-1/4 CT-2521HDB CT-2721HDB CT-3221HDB			

REPLACEMENT PARTS LIST

Models: CT-2511HDB, CT-2521HDB, CT-2721HDB, CT-3221HDB.

Important Safety Notice: Components printed in **BOLD TYPE** have special characteristics important for safety. When replacing any of these components use only manufacturer's specified parts.

REF NO.	PART NO.	DESCRIPTION
R2306	ERJ6GEYJ682	RES,M 6.8K-J-1/10
R2311	ERJ6GEYJ332	RES,M 3.3K-J-1/10
R2312	ERJ6GEYJ682	RES,M 6.8K-J-1/10
R2313	ERJ6GEYJ683	RES,M 68K-J-1/10
R2314	ERJ6GEYJ104	RES,M 100K-J-1/10
R2317	ERJ6GEYJ561	RES,M 560-J-1/10
R2318	ERJ6GEYJ103	RES,M 10K-J-1/10
R2319	ERDS2TJ562	RES,C 5.6K-J-1/4
R2321	ERDS2TJ101	RES,C 100-J-1/4
R2322	ERJ6GEYJ472	RES,M 4.7K-J-1/10
R2353	ERD25FJ1R0	RES,C 1.0-J-1/4
R2356	ERJ6GEYJ682	RES,M 6.8K-J-1/10
R2451	ERJ6GEYJ225	RES,M 2.2MEG-J-1/10
R2455	ERJ6GEYJ153	RES,M 15K-J-1/10
R2456	ERJ6GEYJ103	RES,M 10K-J-1/10
R3005	ERDS2TJ750	RES,C 75-J-1/4
R3006	ERDS2TJ391	RES,C 390-J-1/4
R3009	ERDS2TJ682	RES,C 6.8K-J-1/4
R3010	ERJ6GEYJ334	RES,M 330K-J-1/10
R3011	ERDS2TJ682	RES,C 6.8K-J-1/4 CT-2521HDB CT-2721HDB CT-3221HDB
R3013	ERDS2TJ682	RES,C 6.8K-J-1/4 CT-2521HDB CT-2721HDB CT-3221HDB
R3015	ERJ6GEYJ151	RES,M 150-J-1/10 CT-2721HDB CT-3221HDB
SWITCHES		
S001	EVQPF106K	SWITCH
S002	EVQPF106K	SWITCH
S003	EVQPF106K	SWITCH
S004	EVQPF106K	SWITCH
S005	EVQPF106K	SWITCH
S008	EVQPF106K	SWITCH
S009	EVQPF106K	SWITCH
TRANSFORMERS		
T001	TLP16297	TRANSFORMER, POWER SUPPLY
T501	TLH15452	TRANSFORMER, HORIZONTAL DRIVER

REF NO.	PART NO.	DESCRIPTION
T502	ETE19Z30AY	TRANSFORMER, HORIZONTAL COUPLING
T551	KFT4AB143F	TRANSFORMER, FLYBACK CT-2511HDB CT-2521HDB, CT-2721HDB
T551	KFT5AB106F	TRANSFORMER CT-3221HDB
T751	ETE19Z30BY	TRANSFORMER CT-3221HDB
T801	ETS28AE219NC	TRANSFORMER CT-2511HDB CT-2521HDB CT-2721HDB
T801	ETS29AK2R6NC	TRANSFORMER CT-3221HDB
CRYSTALS/FILTERS		
X001	TSSA010	CRYSTAL
X101	M1969M	SAW FILTER
X102	EFCS4R5MW5BA	FILTER
X201	SFSH4R5MDB	CRYSTAL
X501	TAFCSB503F38	CRYSTAL, CLOCK
X601	TSS2AA001	CRYSTAL, 3.58MHZ
OTHERS		
M001	A63QDB891X	CRT 25" CT-2511HDB CT-2521HDB
M002	EAS12D123JD3	SPEAKER 16 OHM, 3W CT-2721HDB
TNR001	ENV56D37G3R	TUNER
M003	ETC33X82NA	YOKE, CONVERGENCE
M004	M68LGL061X	CRT 27" CT-2721HDB
M005	M80JUA061X	CRT 32" CT-3221HDB
M006	TAS2AA0005	SPEAKER 16-OHM 1.5W CT-3221HDB
M007	TAS2AA0012	SPEAKER 16-OHM 1.5W CT-2511HDB CT-2521HDB
M008	TBM2AA0021	BADGE, PANASONIC CT-3221HDB
M009	TBM2A10141	BADGE, PANASONIC CT-2511HDB CT-2521HDB CT-2721HDB
M010	TXFBX02BSER	ASSY, 7-KEY BUTTON CT-2511HDB CT-2521HDB
M011	TXFBX05BSER	ASSY, 7-KEY BUTTON CT-2721HDB CT-3221HDB
M012	TJSC00300	CRT SOCKET
M013	TKU2AC0513S	ASSY, CABINET BACK CT-2721HDB

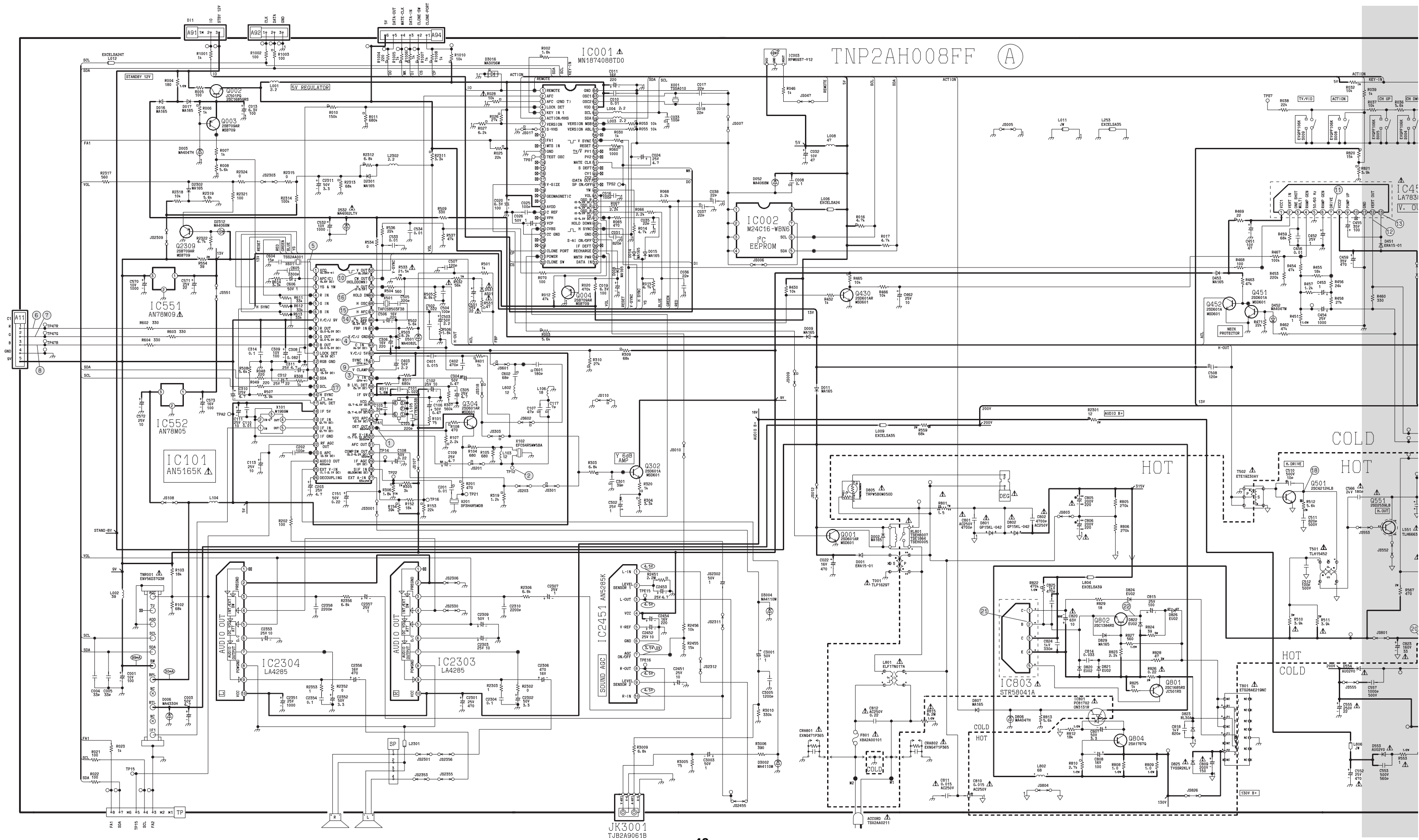
REPLACEMENT PARTS LIST

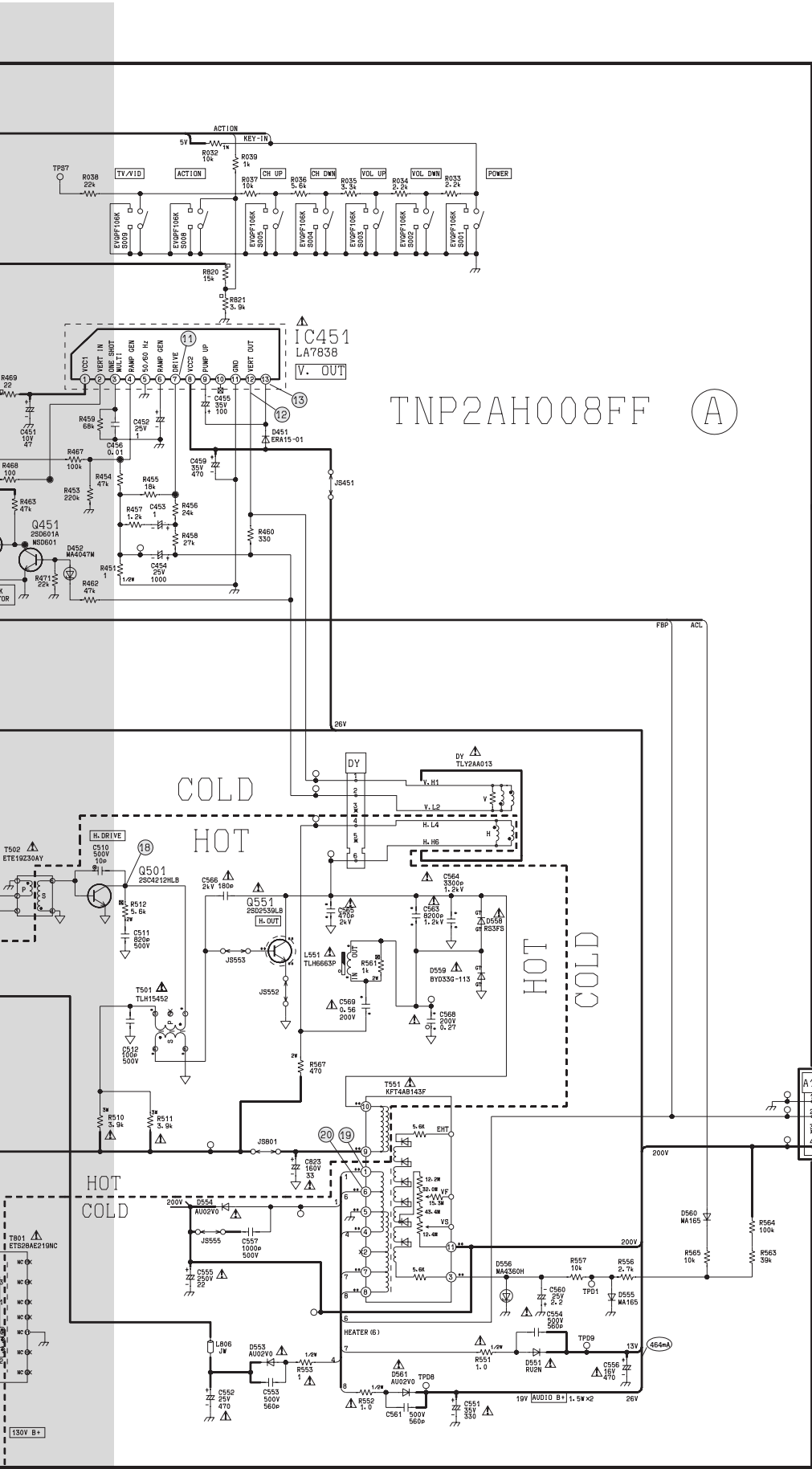
Models: CT-2511HDB, CT-2521HDB, CT-2721HDB, CT-3221HDB.

Important Safety Notice: Components printed in **BOLD TYPE** have special characteristics important for safety. When replacing any of these components use only manufacturer's specified parts.

REF NO.	PART NO.	DESCRIPTION
M014	TKU2AC1104S	ASSY, CABINET BACK <i>CT-3221HDB</i>
M015	TKU2AC1801M	ASSY, CABINET BACK <i>CT-2521HDB</i>
M016	TKU2AC1803M	ASSY, CABINET BACK <i>CT-2511HDB</i>
M017	TKX2AA00401	GUIDE, IR <i>CT-2721HDB CT-3221HDB</i>
M018	TKX2AA00403	GUIDE, IR <i>CT-2511HDB CT-2521HDB</i>
M019	TKY2AA0616S	ASSY, CABINET FRONT <i>CT-2721HDB</i>
M020	TKY2AA1207M	ASSY, CABINET FRONT <i>CT-3221HDB</i>
M021	TKY2AA2203M	ASSY, CABINET FRONT <i>CT-2511HDB</i>
M022	TKY2AA2206M	ASSY, CABINET FRONT <i>CT-2521HDB</i>
DY	TLY2AA003	DEFLECTION YOKE <i>CT-2721HDB</i>
DY	TLY2AA008	DEFLECTION YOKE <i>CT-3221HDB</i>
DY	TLY2AA013	DEFLECTION YOKE <i>CT-2511HDB CT-2521HDB</i>
M023	TQB2AA0361-1	MANUAL, OWNERS
M024	TQB2AA7034	V-CHIP INSTRUCTIONS

REF NO.	PART NO.	DESCRIPTION
DEG	TSP2AA007	COIL, DEGAUSSING 32" <i>CT-3221HDB</i>
M025	TSX2AA0211	LINE CORD (SPT2) <i>CT-2511HDB CT-2521HDB</i>
M026	TSX2AA0212	LINE CORD <i>CT-2721HDB CT-3221HDB</i>
M027	TXF3A01AFR	ASSY., DAG GND <i>CT-3221HDB</i>
M028	TXF3A01ZER	ASSY. DAG GROUND <i>CT-2721HDB</i>
M029	TXF3A0190DA	ASSY., DAG GND <i>CT-2511HDB CT-2521HDB</i>
M030	0FMK014ZZ	CONVERGENCE CORRECTOR STRIP
DEG	0LK19003-1A	COIL, DEGAUSSING 25" <i>CT-2511HDB CT-2521HDB</i>
DEG	0LK19045A	COIL, DEGAUSSING 27" <i>CT-2721HDB</i>
JK1001	TJB2AX0021	MODULAR JACK <i>CT-2521HDB CT-2721HDB CT-3221HDB</i>
JK3001	TJB2AA0291	TERMINAL, A/V <i>CT-2521HDB CT-2721HDB CT-3221HDB</i>
JK3001	TJB2A9061B	BRACKET, A/V <i>CT-2511HDB</i>
JK3002	TJB2AA0034	TERMINAL, A/V <i>CT-2521HDB CT-2721HDB CT-3221HDB</i>





IMPORTANT SAFETY NOTICE

THIS SCHEMATIC DIAGRAM INCORPORATES SPECIAL FEATURES THAT ARE IMPORTANT FOR PROTECTION FROM X-RADIATION, FIRE AND ELECTRICAL SHOCK HAZARDS. WHEN SERVICING IT IS ESSENTIAL THAT ONLY MANUFACTURERS SPECIFIED PARTS BE USED FOR THE CRITICAL COMPONENTS DESIGNATED WITH A  IN THE SCHEMATIC.

NOTA DE SEGURIDAD

LOS DIAGRAMAS ELÉCTRICOS INCLUYEN CARACTERÍSTICAS ESPECIALES MUY IMPORTANTES PARA LA PROTECCIÓN CONTRA RAYOS-X, QUEMADURAS Y DESCARGAS ELÉCTRICAS. CUANDO SE DE SERVICIO ES IMPORTANTE USAR PARA REEMPLAZO DE COMPONENTES CRITICOS, SOLO PARTES ESPECIFICADAS POR EL FABRICANTES. LOS COMPONENTES CRITICOS ESTAN SEÑALADOS EN LOS DIAGRAMAS POR EL SIMBOLO .

Schematic Notes

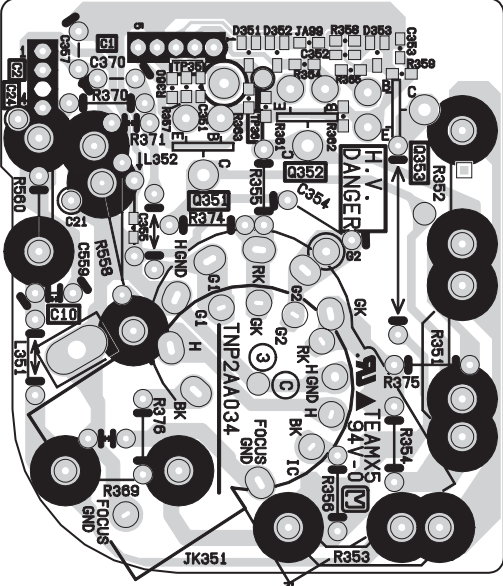
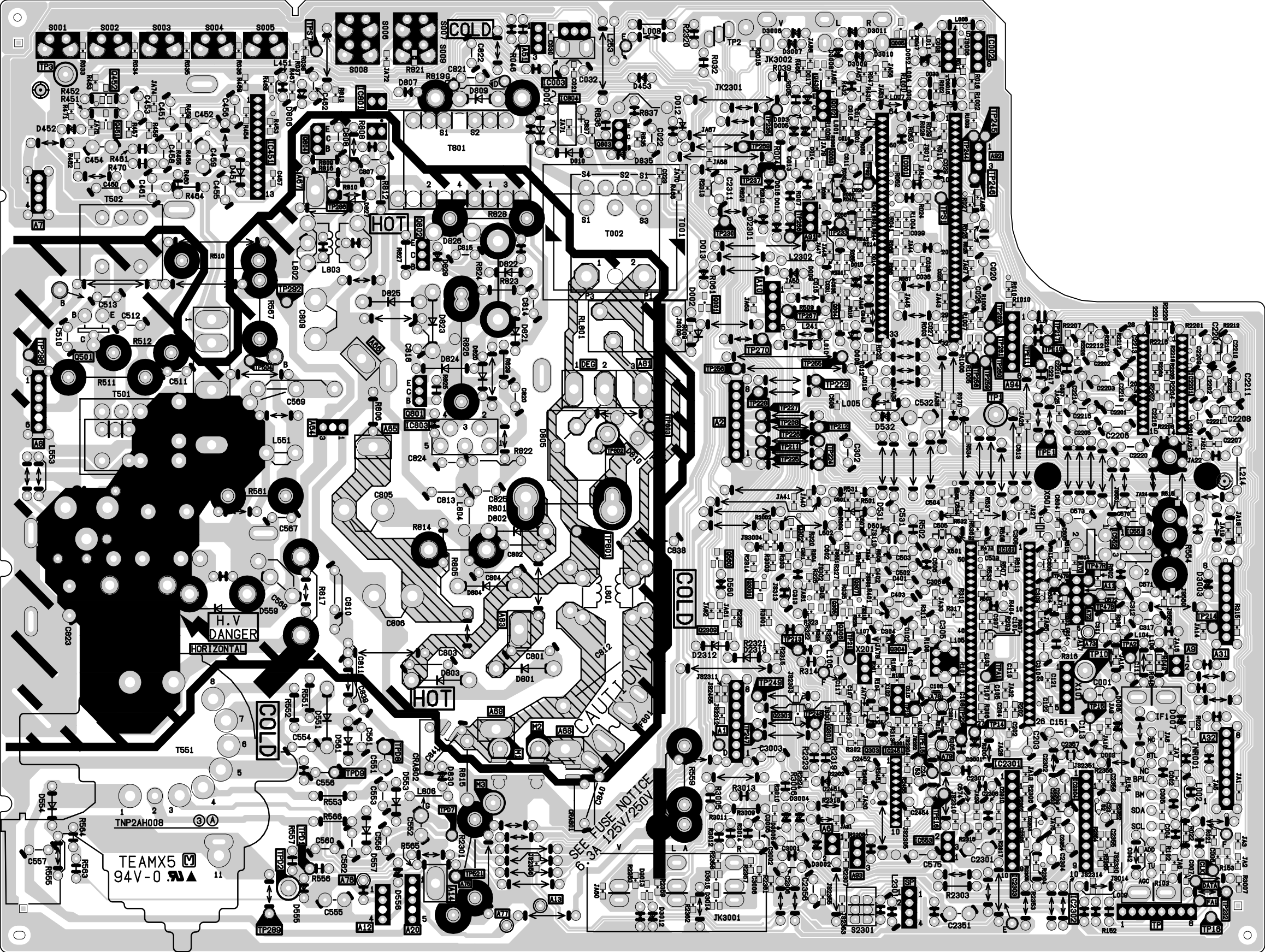
- Resistors are carbon 1/4W unless noted otherwise.
- Capacitors are ceramic 50V unless noted otherwise.
- Coil value notes is inductance in μH .
- Test point indicated by ; Test point but no pin .
- Components indicated with  are critical parts and replacement should be made with manufacture specified replacement parts only.
-  (BOLD LINE) indicates the route of B+ supply.
- The schematic diagrams are current at the time of printing and are subject to change without notice.
- Ground symbol  indicates **HOT GROUND CONNECTION**;  indicates COLD GROUND.

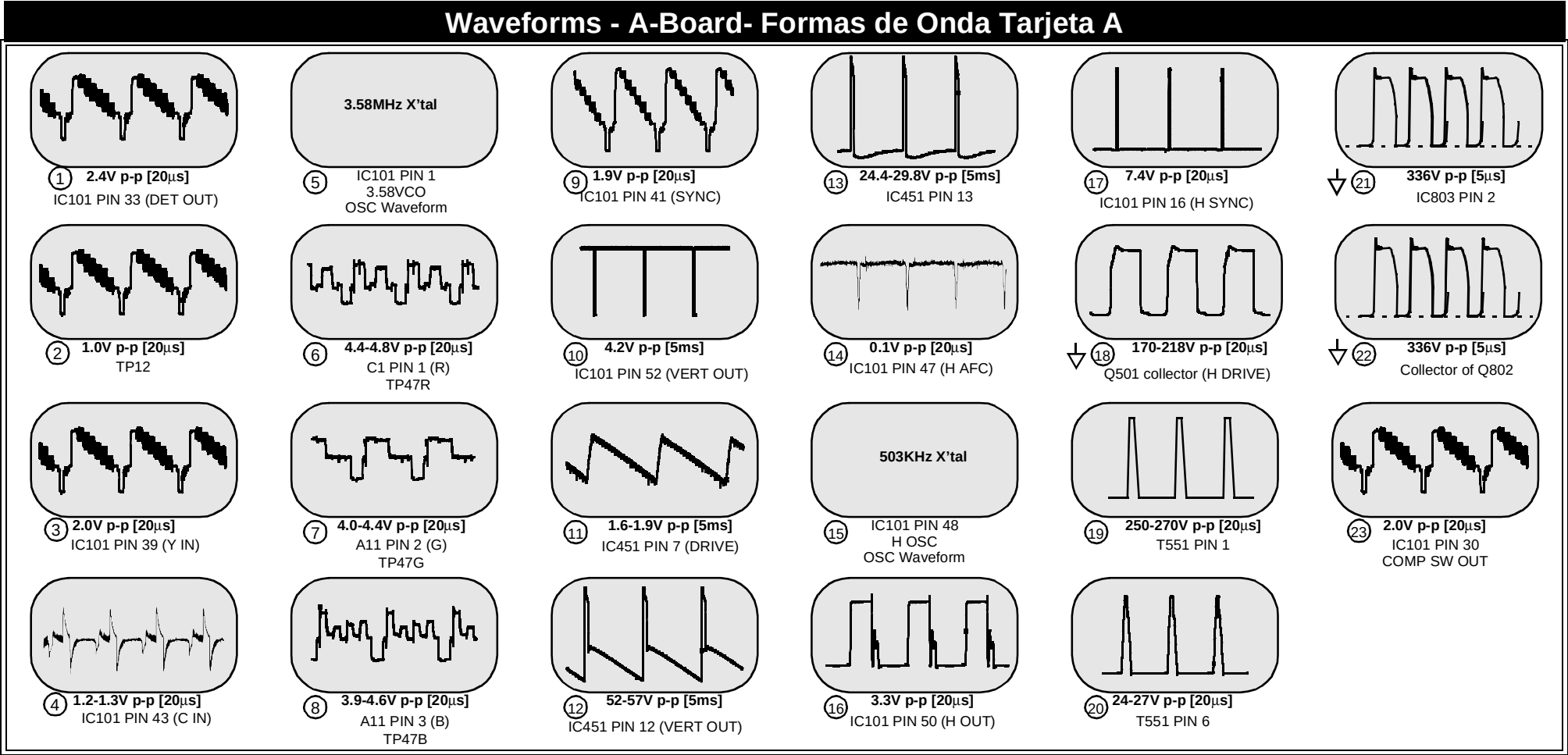
NOTE: All other component symbols are used for engineering design purposes.

Notas de los Diagramas

- Las Resistencias son de Carbón de 1/4W, a menos que se indique otra característica.
- Los Capacitores son de Cerámica para 50V, a menos que se indique otra característica.
- El valor indicado de las Bobinas es la inductancia expresada en μH .
- Los puntos de prueba en la terminal de algún componente son indicados por . Los puntos de prueba fuera de los componentes se indican con .
- Los componentes señalados con el símbolo  son considerados componentes críticos y deben ser reemplazados sólo con las partes especificadas por el fabricante.
-  (LINEA GRUESA) indica las líneas de alimentación de los Voltajes B+.
- Los diagramas eléctricos están sujetos a cambio sin previo aviso.
- El símbolo  indica que es una conexión a **Tierra Caliente** y el símbolo  indica conexión a **Tierra Fría**.

NOTA: Los demas símbolos de componentes incluidos son usados con fines de diseño.





Medición de Formas de Onda

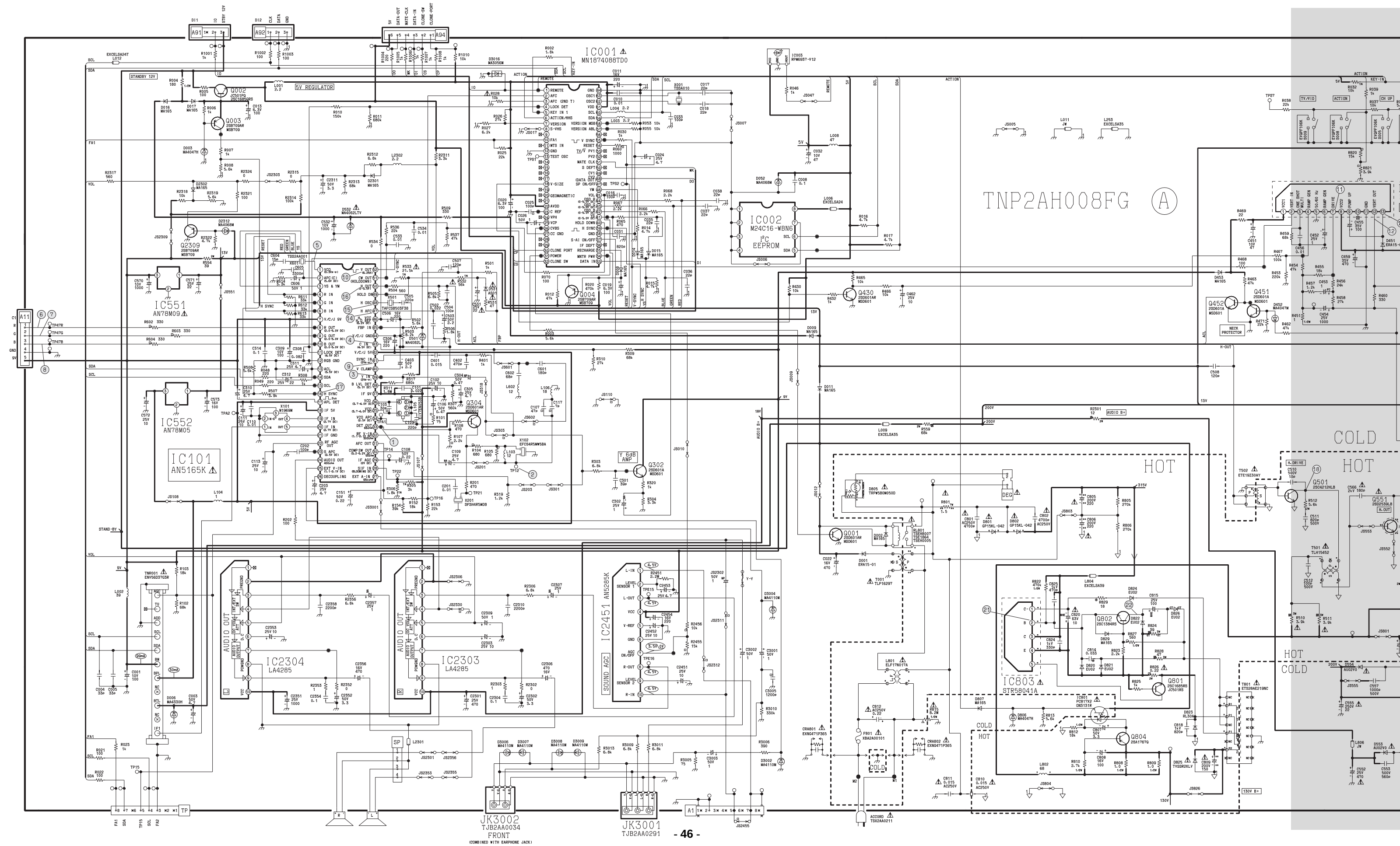
- Un símbolo como ③ indica el punto para medir una señal. (La medición puede hacerse en el punto con mayor accesibilidad, siempre que sea común al indicado.)
- Se midieron utilizando un generador con formato NTSC conectado a la terminal de la antena. (Patrón de 8 Barras de Colores EAI, formato NTSC de 100 IREs para el Blanco y 7.5 IREs para el Negro.)
- Los ajustes de usuario de los Menus PICTURE y AUDIO se normalizaron. Posteriormente el nivel de volumen se ajusta al mínimo.
- Las formas de onda de Video y Color fueron tomadas con un osciloscopio de banda alta y con un punta de prueba de baja capacitancia (10 a 1). La forma y amplitud de las ondas puede variar según el tipo de osciloscopio que se utilice y sus características.
- El símbolo de tierra ↓ que aparece junto al número de la forma de onda, indica que se utiliza conexión a **Tierra Caliente** en el extremo negativo de la punta de prueba.

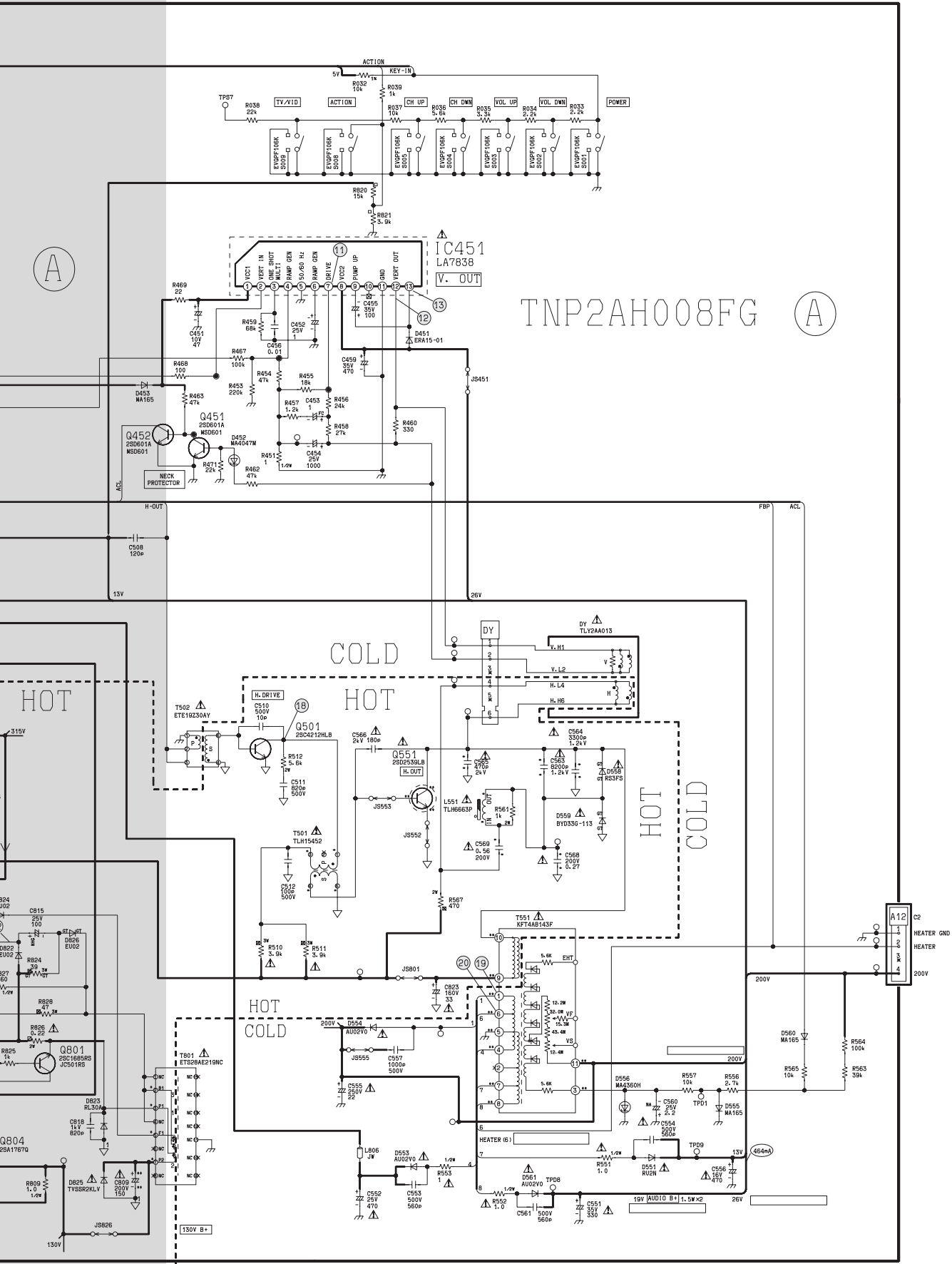
PRECAUCION: Si no se utiliza la conexión a la tierra adecuada, se obtendrán mediciones equivocadas y podría dañar el equipo de medición.

Waveform Measurements

- ③ indicates waveform measurement. (Measurement can be taken at the best accessible location in common to the indicated point.)
- Taken with an NTSC signal generator connected to the antenna terminal. (NTSC color bar pattern of 8 bars of EIA colors, 100 IRE white and 7.5 IRE black.)
- Customer Controls (Picture/Audio Menu) are set to Normalize. Volume is set to "MIN".
- All video and color waveforms are taken with a wideband scope and a probe with low capacitance (10 to 1). Shape and peak altitudes may vary depending on the type of Oscilloscope used and its settings.
- Ground symbol ↓ shown on waveform number indicates (Hot) ground lead connection of the Oscilloscope.

CAUTION: Incorrect ground connection of the test equipment will result in erroneous readings.



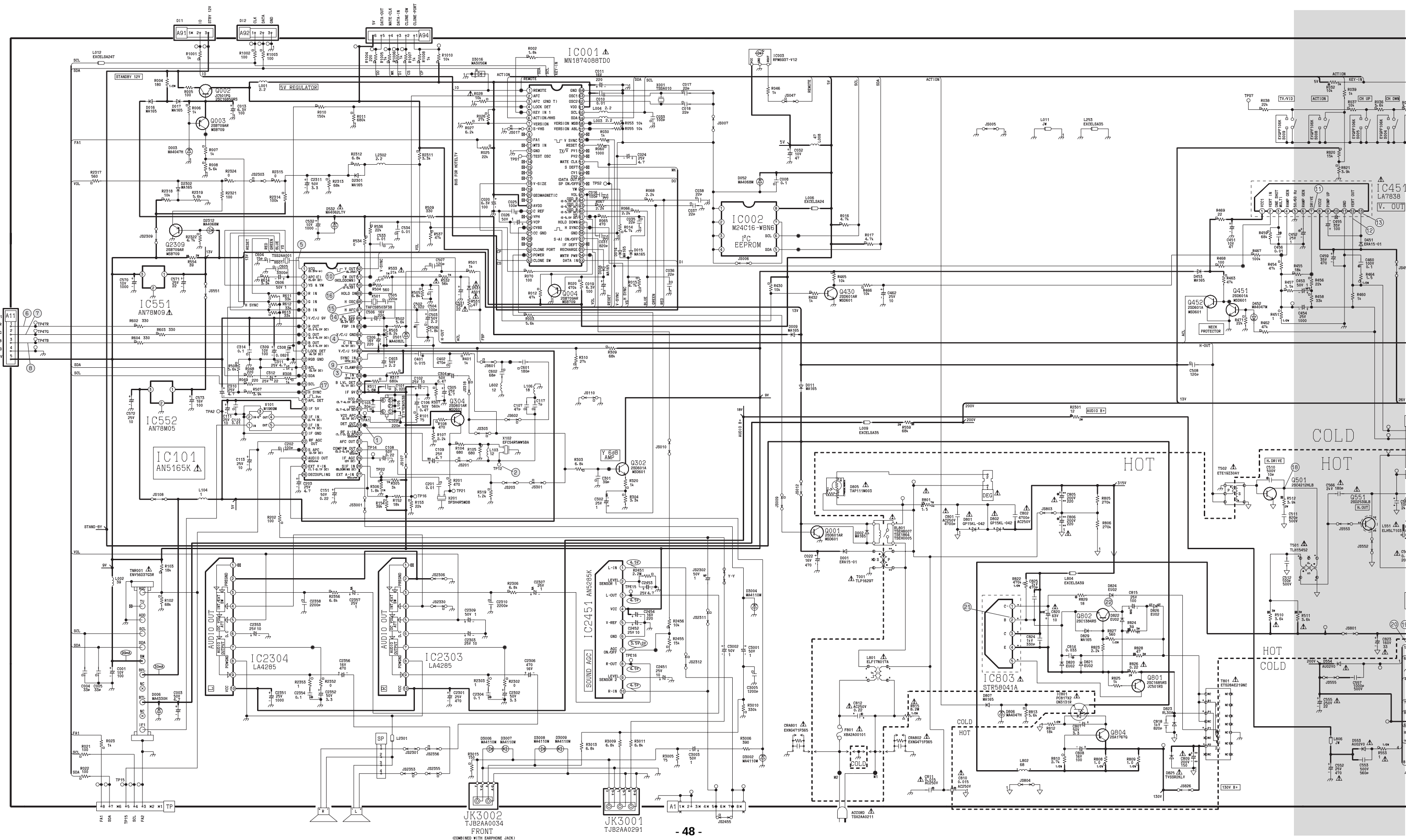


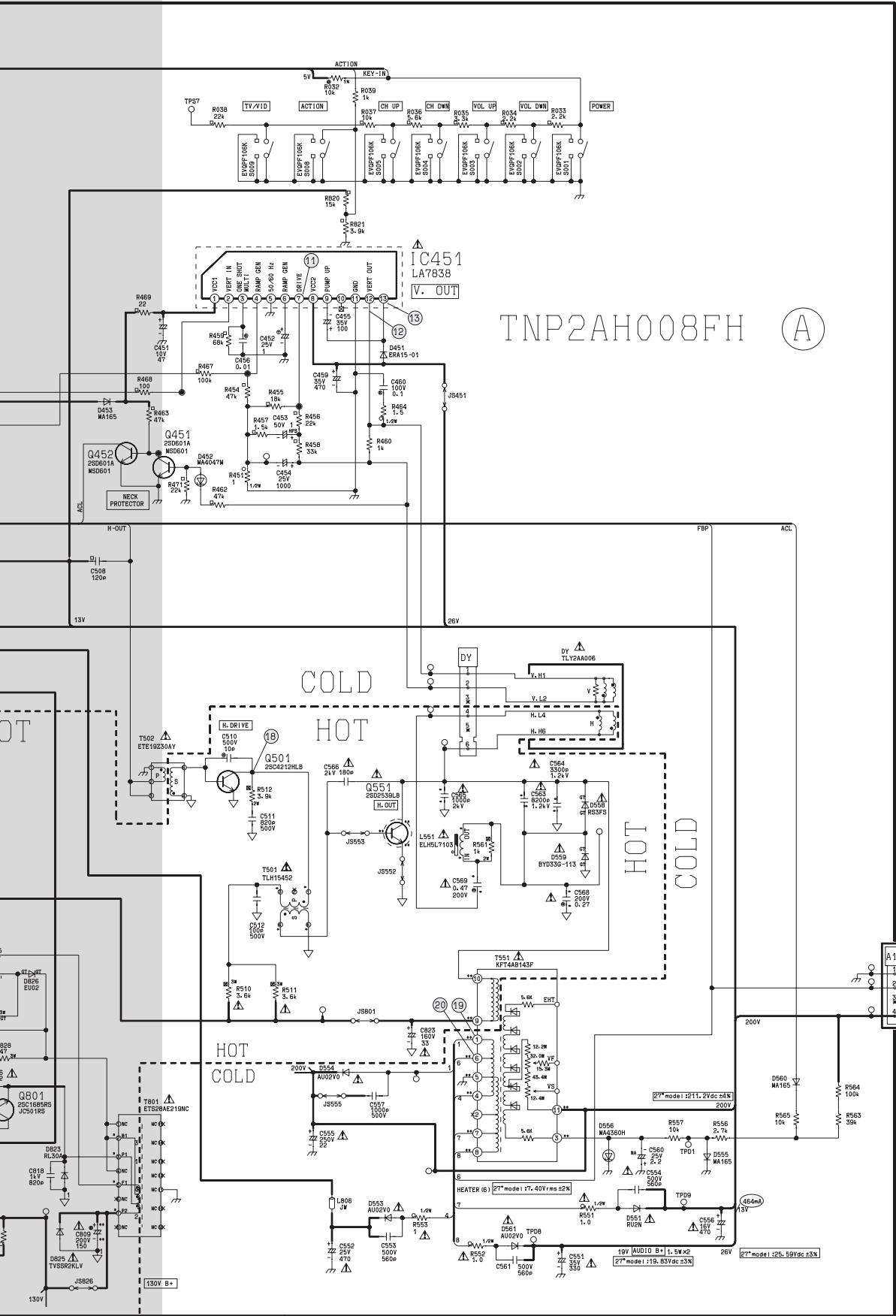
Schematic Notes

- Resistors are carbon 1/4W unless noted otherwise.
 - Capacitors are ceramic 50V unless noted otherwise.
 - Coil value notes is inductance in μH .
 - Test point indicated by $\uparrow$; Test point but no pin $\uparrow$.
 - Components indicated with $\triangle$ are critical parts and replacement should be made with manufacture specified replacement parts only.
 - (BOLD LINE)** indicates the route of B+ supply.
 - The schematic diagrams are current at the time of printing and are subject to change without notice.
 - Ground symbol $\downarrow$ indicates **HOT GROUND CONNECTION**; $\nwarrow$ indicates COLD GROUND.
- NOTE: All other component symbols are used for engineering design purposes.

Notas de los Diagramas

- Las Resistencias son de Carbón de 1/4W, a menos que se indique otra característica.
 - Los Capacitores son de Cerámica para 50V, a menos que se indique otra característica.
 - El valor indicado de las Bobinas es la inductancia expresada en μH .
 - Los puntos de prueba en la terminal de algún componente son indicados por $\uparrow$. Los puntos de prueba fuera de los componentes se indican con $\uparrow$.
 - Los componentes señalados con el símbolo $\triangle$ son considerados componentes críticos y deben ser reemplazados sólo con las partes especificadas por el fabricante.
 - (LINEA GRUESA)** indica las líneas de alimentación de los Voltajes B+.
 - Los diagramas eléctricos están sujetos a cambio sin previo aviso.
 - El símbolo $\downarrow$ indica que es una conexión a **Tierra Caliente** y el símbolo $\nwarrow$ indica conexión a **Tierra Fría**.
- NOTA: Los demas símbolos de componentes incluidos son usados con fines de diseño.





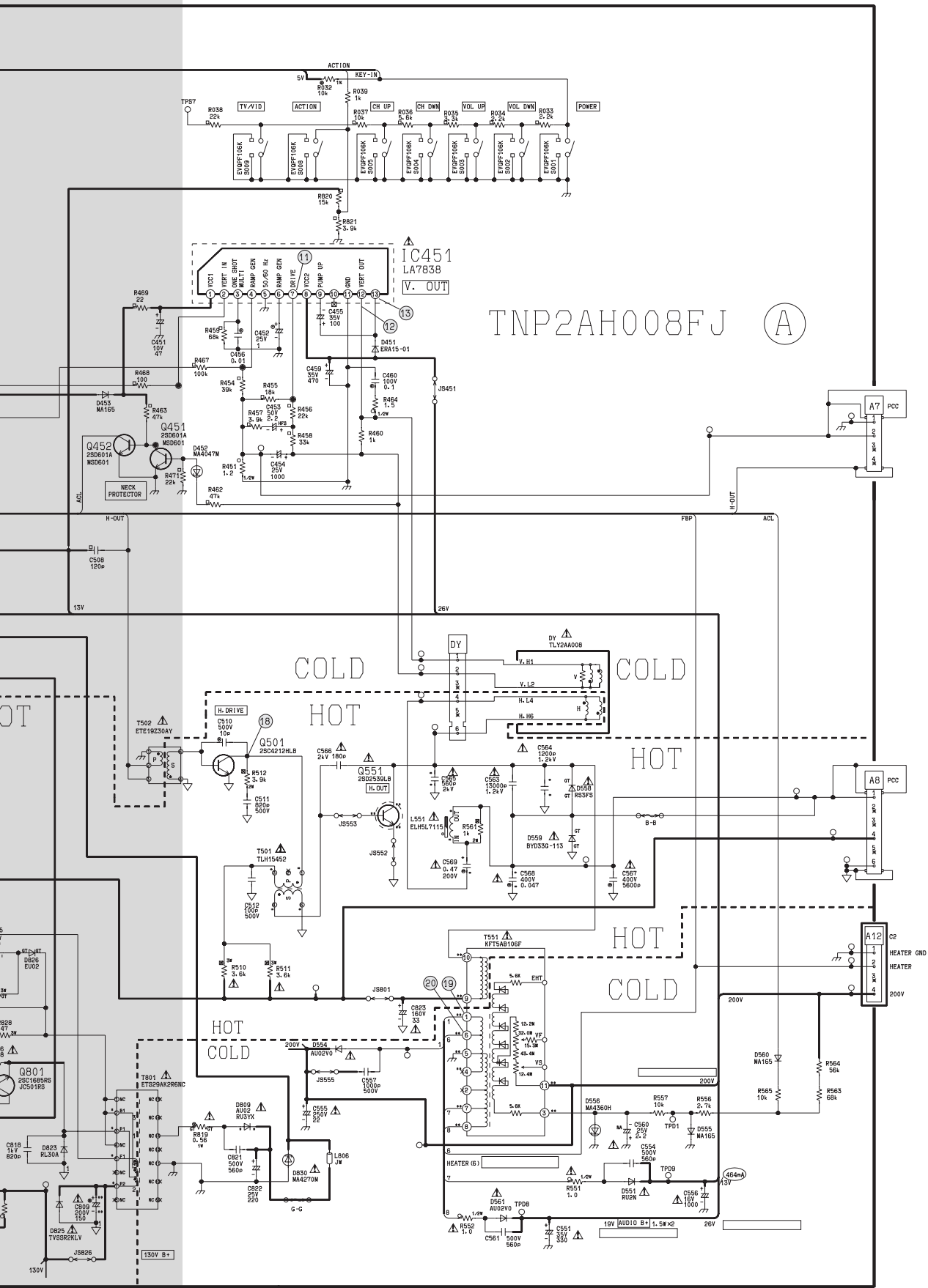
Schematic Notes

1. Resistors are carbon 1/4W unless noted otherwise.
 2. Capacitors are ceramic 50V unless noted otherwise.
 3. Coil value notes is inductance in μH .
 4. Test point indicated by $\blacktriangledown$; Test point but no pin $\{$.
 5. Components indicated with $\triangle$ are critical parts and replacement should be made with manufacture specified replacement parts only.
 6. **—— (BOLD LINE)** indicates the route of B+ supply.
 7. The schematic diagrams are current at the time of printing and are subject to change without notice.
 8. Ground symbol $\blacktriangledown$ indicates **HOT GROUND CONNECTION**; $\blacktriangledown$ indicates COLD GROUND.
- NOTE: All other component symbols are used for engineering design purposes.

Notas de los Diagramas

1. Las Resistencias son de Carbón de 1/4W, a menos que se indique otra característica.
 2. Los Capacitores son de Cerámica para 50V, a menos que se indique otra característica.
 3. El valor indicado de las Bobinas es la inductancia expresada en μH .
 4. Los puntos de prueba en la terminal de algún componente son indicados por $\blacktriangledown$. Los puntos de prueba fuera de los componentes se indican con $\{$.
 5. Los componentes señalados con el símbolo $\triangle$ son considerados componentes críticos y deben ser reemplazados sólo con las partes especificadas por el fabricante.
 6. **—— (LINEA GRUESA)** indica las líneas de alimentación de los Voltajes B+.
 7. Los diagramas eléctricos están sujetos a cambio sin previo aviso.
 8. El símbolo $\blacktriangledown$ indica que es una conexión a **Tierra Caliente** y el símbolo $\blacktriangledown$ indica conexión a **Tierra Fría**.
- NOTA: Los demas símbolos de componentes incluidos son usados con fines de diseño.





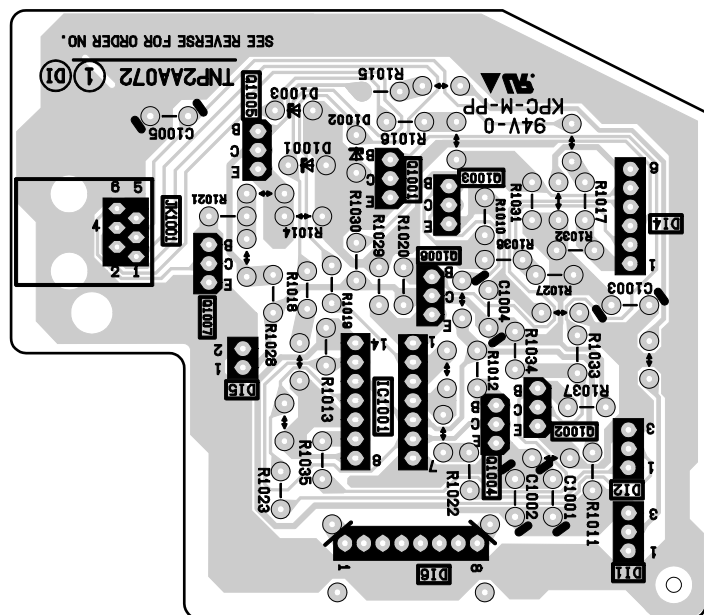
Schematic Notes

1. Resistors are carbon 1/4W unless noted otherwise.
 2. Capacitors are ceramic 50V unless noted otherwise.
 3. Coil value notes is inductance in μH .
 4. Test point indicated by $\uparrow$; Test point but no pin $\downarrow$.
 5. Components indicated with Δ are critical parts and replacement should be made with manufacture specified replacement parts only.
 6. **—— (BOLD LINE)** indicates the route of B+ supply.
 7. The schematic diagrams are current at the time of printing and are subject to change without notice.
 8. Ground symbol $\downarrow$ indicates **HOT GROUND CONNECTION**; $\uparrow$ indicates COLD GROUND.
- NOTE: All other component symbols are used for engineering design purposes.

Notas de los Diagramas

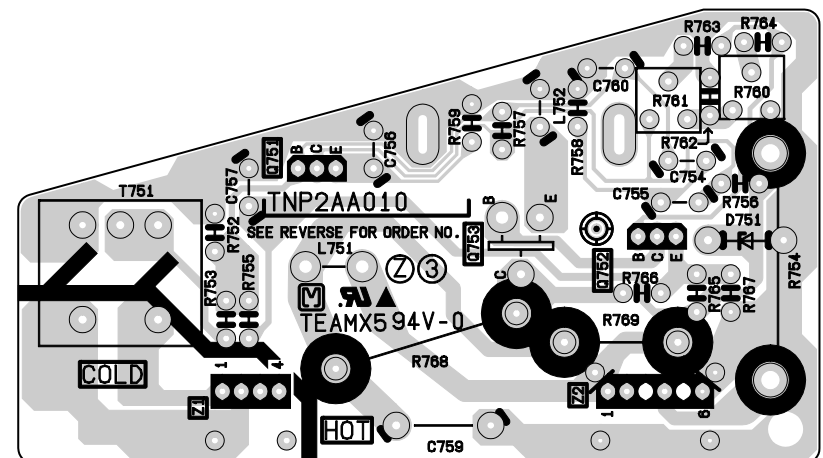
1. Las Resistencias son de Carbón de 1/4W, a menos que se indique otra característica.
 2. Los Capacitores son de Cerámica para 50V, a menos que se indique otra característica.
 3. El valor indicado de las Bobinas es la inductancia expresada en μH .
 4. Los puntos de prueba en la terminal de algún componente son indicados por $\uparrow$. Los puntos de prueba fuera de los componentes se indican con $\downarrow$.
 5. Los componentes señalados con el símbolo Δ son considerados componentes críticos y deben ser reemplazados sólo con las partes especificadas por el fabricante.
 6. **—— (LINEA GRUESA)** indica las líneas de alimentación de los Voltajes B+.
 7. Los diagramas eléctricos están sujetos a cambio sin previo aviso.
 8. El símbolo $\downarrow$ indica que es una conexión a **Tierra Caliente** y el símbolo $\uparrow$ indica conexión a **Tierra Fría**.
- NOTA: Los demas símbolos de componentes incluidos son usados con fines de diseño.

Obtained voltages with a digital multimeter.



IC 1001					
1	.....	0.10	8	.....	0.41
2	.....	0.10	9	.....	0.42
3	.....	0.10	10	.....	0.41
4	.....	5.05	11	.....	5.00
5	.....	0.02	12	.....	0.02
6	....	12.75	13	....	12.75
7	.....	GND	14	....	12.77

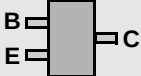
	Q751 ↓	Q752 ↓	Q753 ↓
B	4.44	11.87	0.78
C	11.90	0.77	11.06
E	3.87	12.54	0.68



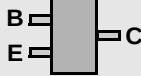
	Q001	Q002	Q003	Q004	Q302	Q304	Q430	Q451
B	0.72	5.93	5.05	5.24	2.92	2.93	0.40	0.63
C	0.08	9.84	5.89	GND	8.86	8.77	2.49	0.02
E	0.00	5.93	5.93	5.24	2.26	2.31	GND	GND

	Q452	Q501 ↓	Q551 ↓	Q801 ↓	Q802 ↓	Q804 ↓	Q2309
B	0.02	0.63	0.67	127.8	130.59	129.81	6.06
C	3.56	84.67	84.67	130.25	118.20	0.68	0.00
E	GND	GND	GND	117.63	117.94	130.22	GND

IDENTIFICACIÓN DE TERMINALES
PARA TRANSISTORES EN *CHIP*



CHIP TRANSISTOR
LEAD DESIGNATION



IC 001		
1	4.65	33 0.36
2	2.52	34 5.27
3	 NC	35 5.28
4	3.45	36 NC
5	5.29	37 5.57
6	2.89	38 GND
7	0.97	39 0.16
8	 GND	40 4.32
9	 NC	41 0.05
10	5.27	42 0.03
11	 NC	43 0.03
12	 GND	44 0.02
13	2.64	45 0.24
14	 NC	46 0.01
15	 NC	47 NC
16	 NC	48 0.66
17	 NC	49 NC
18	0.79	50 NC
19	 NC	51 0.65
20	 NC	52 NC
21	 NC	53 NC
22	5.29	54 reset
23	0.00	55 4.14
24	 NC	56 NC
25	1.28	57 0.01
26	1.82	58 0.01
27	 GND	59 5.03
28	 NC	60 5.03
29	 NC	61 5.29
30	2.95	62 2.46
31	5.23	63 2.29
32	5.13	64 GND

IC 01		
1	2.61	27 5.55
2	5.61	28 3.32
3	0.04	29 2.67
4	0.02	30 2.93
5	0.03	31 4.51
6	0.02	32 2.10
7	8.87	33 2.97
8	3.18	34 2.60
9	3.19	35 3.45
10	3.18	36 3.45
11	4.25	37 8.87
12	 GND	38 3.94
13	3.54	39 4.28
14	5.03	40 2.85
15	5.03	41 4.34
16	0.28	42 4.97
17	3.39	43 2.49
18	4.97	44 GND
19	2.74	45 0.41
20	2.75	46 6.10
21	 GND	47 4.11
22	3.62	48 2.16
23	5.38	49 5.10
24	4.17	50 0.90
25	1.74	51 6.39
26	6.03	52 4.14

IC 002		
1	GND	5 5.03
2	GND	6 5.02
3	GND	7 GND
4	GND	8 5.29

IC 2303		
1	 NC	6 9.83
2	 GND	7 9.91
3	6.28	8 GND
4	 GND	9 9.99
5	0.75	10 20.77

IC 2304		
1	 NC	6 9.74
2	 GND	7 9.81
3	6.28	8 GND
4	 GND	9 9.91
5	0.75	10 20.77

IC 2451		
1	4.97	6 GND
2	1.49	7 3.13
3	4.49	8 4.82
4	8.77	9 8.56
5	4.39	10 4.97

IC 451	
1	 8.00
2	 4.13
3	 4.01
4	 4.06
5	 GND
6	 4.13
7	 3.67
8	 28.10
9	 1.00
10	 NC
11	 GND
12	 14.68
13	 28.92

IC 003	
1	 5.28
2	 GND
3	 4.67

IC 552	
1	12.85
2	 GND
3	4.98

IC 551	
1	12.85
2	 GND
3	8.78

IC 803 ↓	
1	 75.49
2	...130.66
3	...299.15
4	...117.76
5	...130.17

IC 801	
1	 0.68 ↓
2	 0.12 ↓
3	 0.15
4	 12.05

Voltage Measurements

- Voltage measurement:
 - AC input to the Receiver is 120V. NTSC (HD, 1125i & 525P when applicable) signal generator is connected to the antenna of the Receiver. (Color bar pattern of 100 IRE white and 7.5 IRE black.)
 - All Picture and Audio adjustments are set to Normalize.
 - TV ANT/CABLE - (Set-Up Menu) in TV/ANT Mode
 - Volume - Min.
 - TV/Video SW - TV position
 - Audio Mode - Stereo
 - Voltage readings are nominal and may vary ±10% on active devices. Some voltage reading will vary with signal strength and picture content.
 - Supply voltages are nominal.
 - Ground symbol ↓ indicates ground lead connection of meter. Incorrect ground connection will result in erroneous readings.
- CAUTION: Incorrect ground connection of the test equipment will result in erroneous readings.**

Medición de Voltajes

- Medición de voltaje:
 - El voltaje de entrada al Receptor es de 120V de Corriente Alterna. Un generador de patrones con formato NTSC se conecta a la entrada de la antena. (Patrón de Barras de Colores con 100 IREs para el Blanco y 7.5 IREs para el Negro.)
 - Los ajustes de los Menus Picture y Audio se normalizan.
 - En el Menú Set-Up, en la opción ANTENA, se selecciona el modo de CABLE.
 - El nivel de Volumen se minimiza.
 - De los modos TV y Video, seleccionar el modo TV.
 - Seleccionar modo Estereo del Audio.
 - Las mediciones de los voltajes son nominales y pueden variar hasta 10% en componentes en funcionamiento. Las lecturas de los voltajes pueden variar por la potencia de la señal y el contenido de la imagen.
 - Las fuentes de voltajes son nominales.
 - El símbolo ↓ indica el tipo de tierra que se utiliza en la conexión del medidor.
- PRECAUCION: Si no se utiliza la conexión a la tierra adecuada, se obtendrán mediciones equivocadas y podría dañar el equipo de medición.**

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